# 2nd Workshop for Young Researchers in Chemistry

May 19th – 20th

Faculty of Chemistry

University of València

Universitat de València Facultat de Química

## Book contents

## Welcome

Dear colleagues,

The organizing committee kindly welcomes you to the second edition of the Workshop for Young Researchers in Chemistry, which is being held in the Faculty of Chemistry of the University of Valencia.

This second edition, which was originally planned to happen in 2020 but had to be postponed due to the pandemic, will be held in person and in a similar way to the first edition.

The aim of this workshop is to share the research done by PhD students in the different fields of chemistry. This workshop is thought of as an excellent opportunity for every PhD student in chemistry to practice and give an oral communication in a friendly environment and, even, open new multidisciplinary collaboration lines between the different departments of the Faculty. Although the congress has been designed by and for PhD students, undergraduate or Master's students are also welcome to present their research in the format of a poster presentation.

We hope that this workshop is of interest to you, and that you enjoy your time with us.

Organizing committee

## Organising committee

- Inés Adam Cervera. Institut de Ciència dels Materials de la Universitat de València - ICMUV
- María Juliana Cuéllar Zuquin. Institut de Ciència Molecular - ICMOL
- Azahara Doncel Gimenez. Institut de Ciència Molecular - ICMOL
- Daniel Gaviña Rueda. Departament de Química Orgànica
- Belén Lerma Berlanga. Institut de Ciència Molecular - ICMOL
- Miriam Navarrete Miguel. Institut de Ciència Molecular - ICMOL
- Mireia Pérez Baeza. Departament de Química Analítica
- Raquel Rubert Albiol. Institut de Ciència Molecular - ICMOL
- Roberto Sáez Hernández. Departament de Química Analítica
- Paz Sebastiá Luna. Institut de Ciència Molecular - ICMOL
- Ricardo Torán Muñoz. Departament de Química Orgànica

## Coordination

- Prof. Dr. Begoña Milián Medina. Departament de Química Física
- Prof. Dr. Rafael Ballesteros Garrido. Departament de Química Orgànica

## Workshop structure and program

### 19 th of May

| | | |
|---|---|---|
| **14:30 h** | **Registration** | |
| **15:00 h** | **Opening** | |
| **Session 1. Chair: Paz Sebastiá** | | |
| **15:30 h** | **L1** | **Johannes Gierschner: Scientific Misconduct in Current Chemistry Research: Aspects and Conditions** |
| 16:00 h | OC1 | **Alejandro Orellana:** An Excellent MOF Precursor of New Series of Spin-Crossover Clathrates via Single Crystal to Single Crystal Transformation |
| 16:15 h | OC2 | **Javier Carmona:** Photochemical reactivity of atmospheric sulfur compounds of interest in solar geoengineering |
| 16:30 h | OC3 | **Álvaro Seijas:** Covalent modification of layered double hydroxide to modulate their physical and chemical properties |
| **Session 2. Chair: Juliana Cuéllar** | | |
| 16:45 h | OC4 | **Ana Rubio:** Exploring metal-based reactivity in Heterometallic Titanium-Organic Frameworks |
| 17:00 h | OC5 | **Antonio Hernández:** The role of the functional groups in the structure and properties of anilato-based Dy(III) SIMs |
| 17:15 h | OC6 | **Azahara Doncel:** Theoretical insights on self-assembling and optical properties in N-annulated perylene Bisimides aggregates |
| **17:30 h** | **Coffee break & Poster session** | |
| **Session 3. Chair: Daniel Gaviña** | | |
| 18:00 h | OC7 | **Belén Lerma:** Exploiting tetrazine tags to enrich pore complexity: from pyridazine networks to fulleretic materials |
| 18:15 h | OC8 | **Cristina Rodríguez:** Batch and flow synthesis of CeO2 nanomaterials using solid state microwave generators |
| 18:30 h | OC9 | **Adrián Laviós:** Metal-free asymmetric dearomatization of 2-nitrobenzofuranes via formal [3+2] cycloaddition reactions with isocyanoacetates |
| 18:45 h | OC10 | **Paula Escamilla:** A new Zn-MOF used for catalysis and as supported to form Pd- and Ag-SACs |
| **Session 4. Chair: Belén Lerma** | | |
| 19:00 h | OC11 | **Ismael Fernández:** Contactless passivation in metyalammonium lead bromide single crystal |
| 19:15 h | OC12 | **Milorad Andelkovic:** Computational Study of the Reaction Mechanism and the Active Form of Human L-Asparaginase (hASNase3) |
| 19:30 h | OC13 | **Pau Congost:** Deciphering the biomedical performance of antimonene in correlation with is chemical evolution under biological conditions |
| 19:45 h | OC14 | **Ricardo Torán:** Asymmetric organocatalytic arylation of isoxazolin-5-ones with ortho-benzoquinone diimides |

## 20 th of May

| | | |
|---|---|---|
| **Session 5 Chair: Mireia Pérez** | | |
| 9:00 h | OC15 | **Jaume Noguera:** Low-demanding in-situ crystallization method for tunable and stable perovskite nanoparticle thin-films. |
| 9:15 h | OC16 | **Javier Navarro:** Multivariate Metal-Organic Framework as a potential mimicker of active site of enzymes |
| 9:30 h | OC17 | **María Esteve:** Conductivity enhancement in a perylene-based MOF via iodine doping: A theoretical insight. |
| 9:45 h | OC18 | **Roberto Sáez:** A chemometric strategy to distinguish among roman pigments using colorimetric data |
| **Session 6 Chair: Ricardo Torán** | | |
| 10:00 h | OC19 | **Carmen Fernández:** Incorporation of Gold Nanoparticles in Titanium-Organic Frameworks by dynamic methodologies |
| 10:15 h | OC20 | **Juliana Cuéllar:** Decomposition mechanism of the dioxetane derivate of the melanin DHICA-DO: A theoretical study |
| 10:30 h | OC21 | **Daniel Gaviña:** Development of the diastereoselective cross metathesis/cycloaromatization/Pictet-Spengler one pot reaction |
| 10:45 h | OC22 | **Pablo Navarro:** A superoxide dismutase mimetic nanozyme with outstanding antioxidant activity |
| **11:00 h** | **Coffee break & Poster session** | |
| **Session 7 Chair: Roberto Sáez** | | |
| **11:30 h** | **L2** | **Elisa Fernández: Modificación de la Ley de Ciencia y aplicación de la Reforma Laboral en el sector de la investigación** |
| 12:00 h | OC23 | **Mireia Pérez:** Retention behavior and enantioresolution with polysaccharide-based chiral stationary phases and hydroorganic mobile phases of basic and neutral structurally unrelated chiral compounds |
| 12:15 h | OC24 | **Mireia Ruiz:** Coordination and removal of heavy metal ions by boehmite macrocyclic polyamines. |
| 12:30 h | OC25 | **Cristina Negro:** BioMOFs as Environmental Remediation: a Highly and Efficient Removal of Insecticides |
| 12:45 h | OC26 | **Raquel Rubert:** A Theoretical Insight on the Diradical Character of Dicyanomethylene π-Conjugated Compounds |
| **Session 8 Chair: Raquel Rubert** | | |
| 13:00 h | OC27 | **M. Dolores Garrido:** Generalized “one-pot” preparative strategy to obtain highly functionalized silica-based mesoporous spherical particles |
| 13:15 h | OC28 | **Miriam Navarrete:** Theoretical study on the photoinduced repair mechanism of (6-4) photoproduct DNA lesions using oxetane models |
| 13:30 h | OC29 | **Jaume Rostoll:** Light-Driven Electrophilic Functionalization of Quinoxalin-2-ones |
| 13:45 h | OC30 | **Pablo F. Betancur:** Working mechanisms of photodetectors based on High a stable metal-halide perovskite nanocrystals composite with broad Frequency response. |
| **14:00 h** | **Lunch break** | |
| **Session 9 Chairs: Azahara Doncel and Miriam Navarrete** | | |
| 15:30 h | OC31 | **Paola Zezza:** DNA-based Hydrogels for High-performance Microarray and Potential Optical Biosensing Application |
| 15:45 h | OC32 | **Rubén Turó:** Spin crossover modulation via guest interaction in 2D Hofmann-type coordination polymers |
| **16:00 h** | **L3** | **Round table: “Beyond the PhD”** |
| **17:00 h** | **Closure** | |

## Plenary lectures

**Johannes Gierschner** received his Ph.D. in Physical Chemistry at the University of Tübingen (UT), Germany, in 2000. After stays at UT, Univ. Mons (UMons), and at Georgia Tech, Atlanta, he joined the Madrid Institute for Advanced Studies - IMDEA Nanoscience - in 2008 as a Senior Research Professor (Ramón y Cajal fellow 2008-13). In 2014, he habilitated at UT and holds an Adjunct Professor position there since then. He is regular visiting researcher at University of Valencia (since 2014), and at Seoul National University (SNU) since 2008, and held an Adjunct Professor position at SNU and at UMons in 2014/15. His 140 papers (h = 49) integrate optical spectroscopy and computational chemistry to elucidate structure-property relationships in conjugated organic materials for optoelectronics and energy conversion. Besides his research, he is dedicated to consolidate the community knowledge through regular insightful, educative reviews, and is further committed to 'good scientific practice' student courses. Further information: www.uv.es/jogiers

**Elisa Fernández Núñez.** Responsable de comunicación y juventud de la Sección Sindical Estatal de CCOO en el CSIC. Licenciada en Biología con la doble especialidad de Genética y Biotecnología por la Universidad Complutense de Madrid y doctora en Biociencias Moleculares por la Universidad Autónoma de Madrid. Desde el año 2013, Técnica Superior Especializada del Consejo Superior de Investigaciones Científicas (CSIC) en el Instituto de Investigaciones Biomédicas "Alberto Sols".

# Scientific Misconduct in Current Chemistry Research: Aspects and Conditions

**Johannes Gierschner**[1]*

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In the past two decades, awareness of 'good scientific practice' has grown in universities and research institutions, in particular with the increasing cases of fraud and plagiarism, as well as with conflict of interest and authorship. Along with this, also more ethical questions were raised concerning human genetics, animal welfare and data protection, the abuse of confidence or funding, or diversity and gender issues. For these broader ethical concerns, commissions were established[1] and ombudswoman & -men are now frequently appointed,[2] while for scientific misconduct, safeguarding guidelines are readily available.[3,4,5] In any case, such rules usually focus on most obvious violations (like plagiarism and fraud)[6,7] while their increasing, and systematic occurrence provide evidence for a much deeper, inherent crisis in scientific research and publication.

The seminar intends to shed light on these less obvious, but more fundamental aspects of scientific misconduct, being the fertile soil on which the more apparent violations proliferate. Diving deeper below the 'tip of the iceberg', we will discuss examples from current chemical research, having direct practical implications for researchers in the early stage of their career.

In a broader sense, the current crisis in good scientific practice touches the self-conception of science, it's distinction from (in particular applied) research, and its significance in times of a rapidly changing society with grand challenges ahead. Hence, we will then turn to the underlying reasons for the increase of scientific misconduct in research, addressing societal conditions and the implications for science politics, which (partly inadvertently) foster the crisis.[8]

With this in mind, we finally draft fundamental elements of good scientific practice as guidelines for daily work of (young) researchers in (chemical) research.

## References

[1] Universidad Valencia: Comité de Ética, https://www.uv.es/hrs4r/es/areas/aspectos-eticos/comite-etica-uv.html
[2] Universidad Valencia Vice-Rectora de Igualdad, Diversidad y Políticas Inclusivas, https://www.uv.es/uvweb/unidad-igualdad/es/unidad-igualdad-1285869753878.html
[3] German Science Foundation (DFG): Code of Conduct "Guidelines for Safeguarding Good Research Practice", see https://wissenschaftliche-integritaet.de/en/
[4] Universidad Valencia: "Código de Buenas Prácticas", https://www.uv.es/hrs4r/es/areas/aspectos-eticos/codigo-buenas-practicas.html.
[5] COPE - Committee on Publication Ethics: https://publicationethics.org
[6] *Teaching Scientific Ethics Using the Example of Hendrik Schön*, B. J. Feldman, US-China Education Review A **2012**, 4, 418.
[7] *Correcting the Scientific Record: Retraction Practices in Chemistry and Materials Science*, F.-X. Coudert, Chem. Mater. **2019**, 31, 10, 3593.
[8] **For further reading on some relevant aspects**, see e.g.
(a) *Blocking the Hype-Hypocrisy-Falsification-Fakery Pathway is Needed to Safeguard Science*, H. Hopf, S. A. Matlin, G. Mehta, A. Krief, Angew. Chem. Int. Ed. **2020**, 59, 2150.;
(b) *A Role for Funders in Fostering China's Research Integrity*, L. Tang, Science **2022**, 375, 979.;
(c) *To Err is Human; To Reproduce Takes Time*, S. L. Scott, T. B. Gunnoe, P. Fornasiero, C. M. Crudden, ACS Catal. **2022**, 12, 6, 3644.;
(d) *How the Scientific Method Invalidates "Fake News",* M. Carlton, L. Leininger, in: *Teaching About Fake News: Lessons Plans for Different Disciplines and Audiences*, (Ed.: C. Benjes-Small, C. Wittig, M. K. Oberlies). ACRL **2021**.

# Modificación de la Ley de Ciencia y aplicación de la Reforma Laboral en el sector de la investigación

**Elisa Fernández Núñez**[1]*

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El año 2022 está siendo un año de cambios normativos importantes relacionados con cuestiones laborales generales con la Reforma Laboral y, de manera específica en el ámbito la investigación, con la modificación de la Ley 14/2011 de la Ciencia, Tecnología e Innovación.

La modificación del Estatuto de los Trabajadores limitando la contratación temporal, junto a la derogación de la disposición adicional 23ª de la Ley 14/2011 de la Ciencia, Tecnología e Innovación, que mantenía al sector de investigación en una situación de estado de excepción laboral, ha generado la necesidad imperiosa de buscar una nueva fórmula de contratación en el Sistema Español de Ciencia y Tecnología (SECTI), que se ha hecho realidad con la reciente aprobación del Real Decreto-ley 8/2022, de 5 de abril, por el que se adoptan medidas urgentes en el ámbito de la contratación laboral del SECTI.

Por otro lado, la necesaria modificación de la Ley de la Ciencia, que el sector de la investigación lleva reclamando durante años, introduce cambios muy importantes en las condiciones laborales específicas del personal de investigación. Reconocimiento de derechos históricamente reclamados, sobre todo en el personal más precario, un nuevo modelo de contratación indefinida y una modificación en el diseño de carrera investigadora son recogidos en un texto aún pendiente de aprobar en las Cortes Generales. ¿Cuáles son estos cambios tan importantes? ¿Realmente va a cambiar tanto la vida del conjunto del personal de investigación? ¿Cómo afectan estos cambios a los estudiantes de doctorado? ¿Qué es lo que falta para tener la Ley de Ciencia que el sector de la investigación se merece?

## Round table

# Beyond the PhD

**Jose Alberto Carrasco** obtained his degree in Chemistry from the University of Valencia in 2012. Afterwards, he achieved his master's degree in Nanoscience and Nanotechnology in 2014. From 2014 to 2018 he obtained a PhD in the group of Prof. Eugenio Coronado at the Institute of Molecular Science (ICMol), focused on the magnetic and catalytic properties of inorganic two-dimensional materials. After finishing his PhD, he achieved a master's degree in Secondary Education Teaching in 2019 and worked as a postdoctoral fellow both in the ICMol (2019-2020) and the Institue of Chemical Technology (ITQ, 2021). Now he is working in his true passion as a teacher of physics and chemistry, sharing his love for science to the younger generations.

**Javier Segarra-Martí** obtained his PhD in theoretical chemistry and computational modelling at Instituto de Ciencia Molecular (ICMol) under the supervision of Prof. Manuela Merchán and Dr. Daniel Roca-Sanjuán in 2014. From 2014 to 2018 he worked in the group of Prof. Marco Gavarelli, first at the Università di Bologna and later on at the École Normale Supèrieure (ENS) de Lyon. In 2018 he joined Imperial College London as a Marie Curie Fellow, where he worked with Profs. Mike Bearpark and Mike Robb FRS. Since 2020 he has been back at ICMol initially as a Generació de Talent (GenT) Fellow, and currently as a La Caixa MSCA Postdoctoral Junior Leader Fellow, where he works in the broad topics of theoretical photochemistry and spectroscopy.

**Javier Torres** studied chemistry at the University of Valencia (UV) and obtained his B.Sc. degree in 2015. He studied the Master of Organic Chemistry at the UV in 2017. Since then, he has been the recipient of a predoctoral Fellowship from the Valencian ministry "Generalitat Valenciana" and has been carrying out PhD studies on the synthesis of natural products and the evaluation of biological activities of new frameworks in the Department of Organic Chemistry at the UV, under the supervision of Prof. Carlos del Pozo. Now, he is a professor in the private university "Universidad Europea de Valencia", in the dentistry and biotechnology degrees, in several subjects like "anatomy and physiology of the human body" or "Instrumental techniques laboratory".

**Víctor Ignacio Costa Vayá.** Since 2018, he is Director of the UBE Performance Chemicals Business Unit in the Atlantic area. He is responsible for the business strategy of various products produced in Europe and Asia by group companies and industrial partners, for sectors such as special materials in Automotive, Mining, Oil & Gas or intermediates in Flavours and Fragrances, Agrochemicals and Pharmaceuticals. He holds a degree in Chemistry (Extraordinary Career Award 1997) and a PhD in Chemistry, both degrees obtained at the University of Valencia. He also holds a Master's Degree in Business Administration and Management (ESIC, 2005).

**Inmaculada Conejos Sánchez** obtained her PhD in Organic Chemistry in the Chemical & Pharmaceutical Industry in 2013 at Centro de Investigación Príncipe Felipe. In July 2015, she was awarded with a Val i+d postdoctoral grant between her PhD lab and the Department of Clinical Neuroscience in the University of Cambridge (UK). Her project focused on the design, development and biological evaluation of novel non-viral gene delivery vectors for treatment of progressive forms of multiple sclerosis using siRNA as the bioactive molecule. In 2021 she was awarded the AECC Investigador grant for developing novel combination therapies for the treatment of pediatric solid tumors at the Hospital Sant Joan de Deu in Barcelona (Spain).

## Oral contributions

**OC1. Alejandro Orellana-Silla**. An Excellent MOF Precursor of New Series of Spin-Crossover Clathrates via Single Crystal to Single Crystal Transformation

**OC2. Javier Carmona García**. Photochemical reactivity of atmospheric sulfur compounds of interest in solar geoengineering.

**OC3. Álvaro Seijas-Da Silva**. Covalent modification of layered double hydroxide to modulate their physical and chemical properties.

**OC4. Ana Rubio Gaspar**. Exploring metal-based reactivity in Heterometallic Titanium-Organic Frameworks.

**OC5. Antonio Hernández Paredes**. The role of the functional groups in the structure and properties of anilato-based Dy(III) SIMs

**OC6. Azahara Doncel Giménez**. Theoretical insights on self-assembling and optical properties in N-annulated perylene Bisimides aggregates.

**OC7. Belén Lerma-Berlanga**. Exploiting tetrazine tags to enrich pore complexity: from pyridazine networks to fulleretic materials.

**OC8. Cristina Rodríguez Carrillo**. Batch and flow synthesis of CeO2 nanomaterials using solid state microwave generators.

**OC9. Adrián Laviós Gomis**. Metal-free asymmetric dearomatization of 2-nitrobenzofuranes via formal [3+2] cycloaddition reactions with isocyanoacetates.

**OC10. Paula Escamilla-Belenguer**. A new Zn-MOF used for catalysis and as supported to form Pd- and Ag-SACs.

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**OC12. Milorad Andelkovic**. Computational Study of the Reaction Mechanism and the Active Form of Human L-Asparaginase (hASNase3).

**OC13. Pau Congost i Escoin**. Deciphering the biomedical performance of antimonene in correlation with is chemical evolution under biological conditions.

**OC14. Ricardo Torán Muñoz**. Asymmetric organocatalytic arylation of isoxazolin-5-ones with ortho-benzoquinone diimides.

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**OC16. Javier Navarro Alapont**. Multivariate Metal-Organic Framework as a potential mimicker of active site of enzymes.

**OC17. María Esteve Rochina**. Conductivity enhancement in a perylene-based MOF via iodine doping: A theoretical insight.

**OC18. Roberto Sáez-Hernández**. A chemometric strategy to distinguish among roman pigments using colorimetric data.

**OC19. Carmen Fernández-Conde**. Incorporation of Gold Nanoparticles in Titanium-Organic Frameworks by dynamic methodologies.

**OC20. Juliana Cuéllar-Zuquin**. Decomposition mechanism of the dioxetane derivate of the melanin DHICA-DO: A theoretical study.

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**OC28. Miriam Navarrete Miguel**. Theoretical study on the photoinduced repair mechanism of (6-4) photoproduct DNA lesions using oxetane models.

**OC29. Jaume Rostoll-Berenguer**. Light-Driven Electrophilic Functionalization of Quinoxalin-2-ones.

**OC30. Pablo F. Betancur**. Working mechanisms of photodetectors based on High a stable metal-halide perovskite nanocrystals composite with broad Frequency response.

**OC31. Paola Zezza**. DNA-based Hydrogels for High-performance Microarray and Potential Optical Biosensing Application

**OC32. Rubén Turó-Cortés.** Spin crossover modulation via guest interaction in 2D Hofmann-type coordination polymers.

# An Excellent MOF Precursor of New Series of Spin-Crossover Clathrates via Single Crystal to Single Crystal Transformation

**A. Orellana-Silla[1], F.J. Valverde-Muñoz[1]*, M.C. Muñoz[2], C. Bartual Murgui[1], S. Ferrer[3], and J.A. Real[1]***

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Here we report the use of the porous $Fe^{II}$ Spin-Crossover[1] (SCO) framework $[Fe(tvp)_2(NCS)_2]@4(CH_3CN{\cdot}H_2O)$ [**$1@(4(CH_3CN{\cdot}H_2O))$**] (tvp = trans-(4,4'-vinylenedipyridine) as an excellent platform to the synthesis of new SCO clathrates via single-crystal to single-crystal (SCSC) procedure. The method consists in soaking the precursor's single crystals in a series of liquid halobenzene derivatives ($PhX_n$: X=Cl (n=1,2), X=F (1-3, 4 (two isomers), 5, 6), X= Br (n=1)). This procedure induces the complete exchange of the guest molecules of the initial framework with the halobenzene derivatives obtaining, therefore, the series of halobenzene clathrates $1@PhX_n$. Single crystal analysis shows that the halobenzene guests fill in the gaps of the nanochannels of the framework assembling themselves in pairs via π-stacking interactions. The thermal dependence of the magnetic and calorimetric properties depicts a practically complete SCO in all the clathrates. The difference between each characteristic SCO equilibrium temperature, $T_{1/2,}$ resides in the subtle differences in guest interactions with the host framework, which are temperature and spin-state dependent. The most interesting of them, 1@PhCl2, manifests a four-step SCO behavior caused by a radically distinct supramolecular organization of the halobenzene guest, a depiction of the subtle changes in the structure can be found in Figure 1[2].

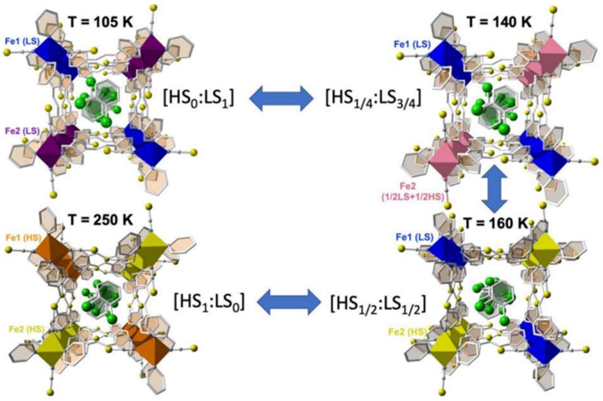

**Figure 1.** Fragment of the structure of $1@2PhCl_2$ showing the guest $PhCl_2$ molecules in the middle of the channels and the spin-state change of the FeII octahedral nodes. Color codes: Fe1 (LS), blue; Fe2 (LS), garnet; Fe2 (HS), yellow; Fe1 (HS), brown; Fe2 (1/2HS+1/2LS), pink.

## References

[1] a) Gütlich, P.; Goodwin, H. A. (Eds) *Top. Curr. Chem.* **2004**, *233*, Springer; b) Muñoz, M. C.; Real, J. A. *Coord. Chem. Rev.* **2011**, *255*, 2068-2093.
[2] Orellana-Silla, A.; Valverde-Muñoz, F.J.; Muñoz, M.C.; Bartual Murgui, C.; Ferrer, S.; Real, J.A. *Inorg. Chem.* **2022**, *61*, 4484-4493.

# Photochemical reactivity of atmospheric sulfur compounds of interest in solar geoengineering

**J. Carmona-García[1,2], A. Francés Monerris[3], T. Trabelsi[4], C. A. Cuevas[2], A. Saiz-Lopez[2*], J.S. Francisco[4*], D. Roca-Sanjuán[1*]**

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Global warming is one of the most challenging and defining issues of our time. Because of that, there is an urgent need to find drastic solutions to counteract the rising of Earth's global average temperature since the 19th century. On that regard, solar geoengineering techniques aim to cool our planet by reflecting sunlight back into space. One of the most promising techniques of this kind consists in the injection into the stratosphere of large quantities of sulfur dioxide ($SO_2$) to induce the subsequent formation of sulfuric acid ($H_2SO_4$), a highly hygroscopic species that can form light-reflecting sulfate aerosol particles, which would act as a mirror for incident solar radiation, decreasing global temperatures in a similar way as it occurs after volcanic eruptions [1]. However, the atmospheric chemical implications and the potential environmental effects of this geoengineering proposal demand urgent studies to evaluate its viability. More specifically, a complete description of the photochemical reactivity of the participant species is mandatory.

By means of state-of-the-art quantum chemical methodologies, we have studied the photochemical properties and photodissociation pathways of key sulfur species in the generation of sulfate aerosols in the stratosphere: *cis*-HOSO [2], $HOSO_2$, and $SO_3$ [3]. The former species arises from the reaction of $SO_2$ in its lowest excited triplet state with water, while the remaining systems act as intermediates in the traditional acid rain generation scheme, the central chemical mechanism of this solar geoengineering proposal. In summary, the photodynamics of *cis*-HOSO after sunlight absorption in the wavelength range of stratospheric interest leads to the dissociation of the radical, generating mainly OH and SO with a minor production of O and H atoms, exhibiting an averaged stratospheric photolysis lifetime of ~416 s. In the case of $HOSO_2$, its averaged stratospheric photolysis lifetime is of ~70 s and the main photodissociation channel corresponds to the breaking of the HO-$SO_2$ bond, with the production of HOSO and a single oxygen atom arising as a secondary channel. The results obtained suggest that the photochemistry of both systems may only have an impact in the production rate of sulfate aerosol in atmospheric regions with low $O_2$ concentration, the primary sink species for these sulfur radicals. On the contrary, $SO_3$ appears to be photostable with a long photolysis lifetime of 579 days in Earth's stratosphere, indicating that the efficiency of $H_2SO_4$ generation from association of $SO_3$ and $H_2O$ may be affected by largely unknown $SO_3$ removal processes. Future modelling studies will be necessary to explore new removal mechanisms of this paramount intermediate in sulfate aerosol generation.

## References

[1] Tuck, A. F.; Donaldson, D. J.; Hitchman, M. H.; et al. *Clim. Change.* **2008**, *90,* 315−331.
[2] Carmona-García, J.; Francés-Monerris, A.; Cuevas, C. A.; et al. *J. Am. Chem. Soc.* **2021**, *143*, 10836-10841.
[3] Carmona-García, J.; Trabelsi, T.; Francés-Monerris, A.; et al. *J. Am. Chem. Soc.* **2021**, *143*, 18794-18802.

# Covalent modification of layered double hydroxide to modulate their physical and chemical properties

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Chemical functionalization is a powerful approach to modulate the physical and chemical properties of two-dimensional (2D) materials, increasing their processability, tuning their functionalities, and creating new 2D heterostructures via a chemical approach. Furthermore, surface engineering can lead to the rational modification of the interface properties of the layers, in order to create hybrid structures for efficient energy store and conversion systems. [1] Layered double hydroxides (LDHs) are a class of cationic layers with exchangeable anions in the interlayer space that exhibit a hydrotalcite-like structure. The high tunability of these phases from the point of view of metallic composition, stoichiometry, and the interlayer anion gives LDHs a wide versatility; resulting in different applications such as catalysis, gas barrier, flame retardant, sensing, magnetism or energy storage and conversion, to name a few.

Post-functionalization of bare LDHs by covalent bonds beyond silane-based molecules is one of the most important challenges in the field of LDHs. One alternative route to achieve this goal is the direct synthesis of LDHs with covalently attached molecules. In this field, organic molecules with the capacity to create a complex with the LDHs cation in solution arise as a perfect option.

Keeping in mind this, we perform the functionalization with tris(hydroxymethyl) aminomethane, using a modified hydrothermal method from Kuroda et al., [2] of different LDH compositions (NiFe, CoFe and NiV-LDHs), due to their great interest as electrocatalytic materials in the oxygen evolution reaction (OER). Taking this organic-LDHs covalent hybrid as a building block, chemistry approximations based on covalent bonds have been successfully used to obtain 2D-molecules system and 2D-2D heterostructures.

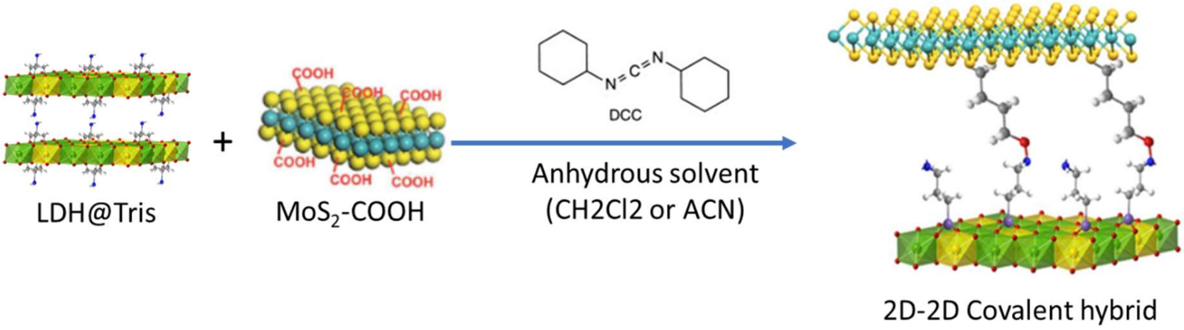

**Figure 1.** Schematic representation of 2D-2D covalent hybrid.

**References**

[1] Xiong, P.; Sun, B.; Sakai, N.; Ma, R.; Sasaki, T.; Wang, S.; Zhang, J.; Wang, G. *Advanced Materials*. **2020**, *32* (18), 1902654

[2] Muramatsu, K.; Hayashi, S.; Kuroda, Y.; Oka, Y.; Wada, H.; Shimojima, A.; Kuroda, K. *Inorganic Chemistry*. **2020**, *59*, 6110−6119.

# Exploring metal-based reactivity in Heterometallic Titanium-Organic Frameworks

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The use of Metal-Organic Frameworks, MOFs, as catalysts offer great advances due to its sizeable pore and its chemical versatility. This, together with the possibility of understanding how the reagents interact within the crystalline framework, opens the door to advancing in terms of performance and selectivity in relevant processes.

Here we demonstrate how using an heterometallic MOF can increase the catalytic activity by controlling the distribution of the different metals in the structure. To do so, we use the Epoxide Ring-Opening Reaction as a model reaction and the heterometallic MUV-101(M)[1][2] family as catalyst. The influence of the identity as well as the distribution of the metals in the MOF was studied both experimentally and computationally. Our findings point out that heterometallic MUV-101(Fe) is a significantly more active catalyst in comparison to the other heterometallic MOFs as well as their homometallic counterparts. Moreover, this boost in catalytical activity cannot be achieved through a physical mixture of the homometallic Ti and Fe MOFs, MIL-100(Ti) and MIL-100(Fe), reinforcing the paramount importance of the cluster composition, which can only be controlled by means of heterometallic MOFs.

All in all, by using this heterometallic MUV-101(M), high catalytic activities can be achieved, being comparable to other benchmark MOFs and not requiring any further modification of the material, as it can sometimes be the case. Thus, these results pave the way to exploiting the potential of MOFs as heterogeneous catalysts.

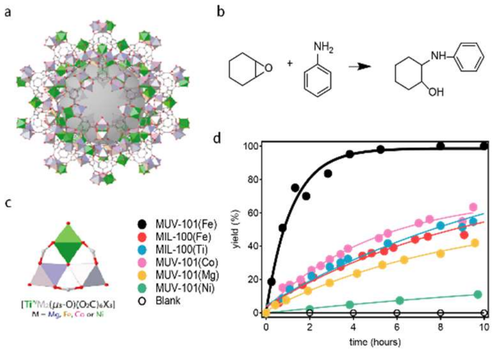

**Figure 1.** (a) Structure of MUV-101(M), (b) Scheme of the Epoxide Ring-Opening Reaction (ROR) of cyclohexene oxide with aniline, (c) cluster composition of MUV-101(M) (d) catalytic activity of the MUV-101(M) family in the Epoxide of illustration.

**References**

[1] M. Padial, Lerma-Berlanga, Martí-Gastaldo et al., *J. Am. Chem. Soc*, **2020**, *142*, 6638-6648.

[2] Castells-Gil, Martí-Gastaldo et al., *Chem*, **2020**, *6*, 3118-3131

# The role of the functional groups in the structure and properties of anilato-based Dy(III) SIMs

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The search for 2D and 3D coordination polymers with slow relaxation of the magnetization of molecular origin (single-molecule magnets, SMM) or due to a single ion (single-ion magnets, SIM) is, nowadays, a hot topic. Herein, we report the synthesis, structure and magnetic properties of a new series of 2D Dy(III)-based SIMs with four different anilato-type ligands (derivatives of the 2,5-dihydroxy-1,4-benzoquinone: $C_6O_4X_2^{2-}$, with X = H, Cl, Br and CN/Cl) and dimethyl sulfoxide (dmso).[1-4] The structures of the compounds synthesized, formulated as: $[Dy_2(C_6O_4H_2)_3(dmso)_2(H_2O)_2]\cdot 2dmso\cdot 18H_2O$ (**1**), $[Dy_2(C_6O_4Cl_2)_3(dmso)_4]\cdot 2dmso\cdot 2H_2O$ (**2**) and $[Dy_2(C_6O_4Br_2)_3(dmso)_4]\cdot 2dmso\cdot 2H_2O$ (**3**) show that all of them present a (6,3)-2D network with distorted hexagonal honeycomb layers. The solvent molecules are located in the interlayer space and in the hexagonal channels formed perpendicular to the layers. We also present the magnetic properties of a recently reported related compound: $[Dy_2(C_6O_4Cl_2)_3(dmso)_6]$ (**4**).[4] The magnetic measurements show that compounds **1-4** present slow relaxation of the magnetization when a DC field is applied (field-induced SIM, FI-SIM). Besides, compound **1** also presents SIM behaviour without the application of any DC field. Furthermore, in this work, we discuss the differences caused by the X group of the anilato ligands in the structures and magnetic properties in **1-4**.

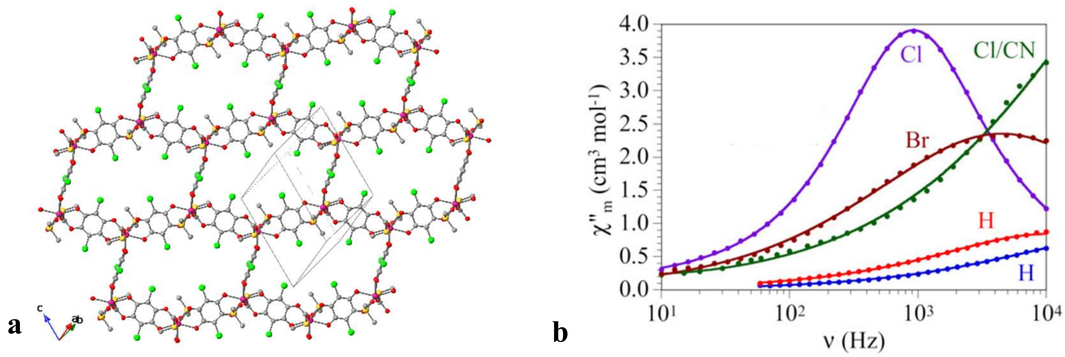

**Figure 1. (a)** Top view of one layer in **2. (b)** Frequency dependence of $\chi''_m$ for compounds **1-4** at 1.9 K and 100 mT (0 mT in blue and 60 mT in red for X = H) . Colour code in (**a**): Dy = pink, C = grey, O = red, Cl = green and S = yellow.

**Acknowledgments**

We thank the grant CTQ2017-87201-P funded by MCIN/AEI/10.13039/501100011033 and by “ERDF A way of making Europe”, the Generalidad Valenciana (Prometeo/2019/076) and the grant FPU17/03216 funded by MCIN/AEI/10.13039/501100011033 and by “ESF Investing in your future” for financial support.

**References**

[1] Benmansour, S.; Hernández-Paredes, A.; Bayona-Andrés, M.; Gómez-García, C.J. *Molecules* **2021**, *26*, 1190.

[2] Benmansour, S.; Hernández-Paredes, A.; Mondal, A.; López Martínez, G.; Canet-Ferrer, J.; Konar, S.; Gómez-García, C.J. *Chem. Commun.* **2020**, *56*, 9862–9865.

[3] Benmansour, S.; Hernández-Paredes, A.; Gómez-García, C.J. *J. Coord. Chem.* **2018**, *71*, 845–863.

[4] Sahadevan, S.A.; Monni, N.; Abhervé, A.; Cosquer, G.; Oggianu, M.; Ennas, G.; Yamashita, M.; Avarvari, N.; Mercuri, M.L. *Inorg. Chem.* **2019**, *58*, 13988–13998.

# Theoretical insights on self-assembling and optical properties in N-annulated perylene Bisimides aggregates

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Perylene bisimide (PBI) and its derivatives have aroused considerable attention due to their applications in diverse fields ranging from optical switches to organic light-emitting diodes (OLEDs).[1] PBIs are organic $\pi$-conjugated compounds and show excellent optical, photophysical, and optoelectronic properties. PBIs are prone to self-assembly due to the $\pi$-$\pi$ interaction of the $\pi$-conjugated cores, and the structure of the aggregate can be controlled by peripheral substitution. The structure and the nature of the interactions present in these supramolecular aggregates play a crucial role in the absorbance and fluorescence properties of the corresponding material.[2]

In this work, we present a quantum-chemical characterization of the structural, electronic, and optical properties of N-annulated PBI derivatives and their possible supramolecular aggregates by using the density functional theory (DFT) and the tight-binding semiempirical GFN2-xTB quantum-chemical method. Moreover, to get a better understanding of the optical properties of PBI derivates supramolecular polymers, an Frenkel/CT-type excitonic Hamiltonian was constructed to simulate the absorption electronic spectra. The study has been performed on two PBI derivatives (Figure 1), which share the same $\pi$-conjugated core, but different peripheral substituents attached to the imide positions (ethyl benzoate groups for **1** and phenyl groups for **2**). The change of the peripheral substituents has a strong effect on the aggregation and optical properties.[3]

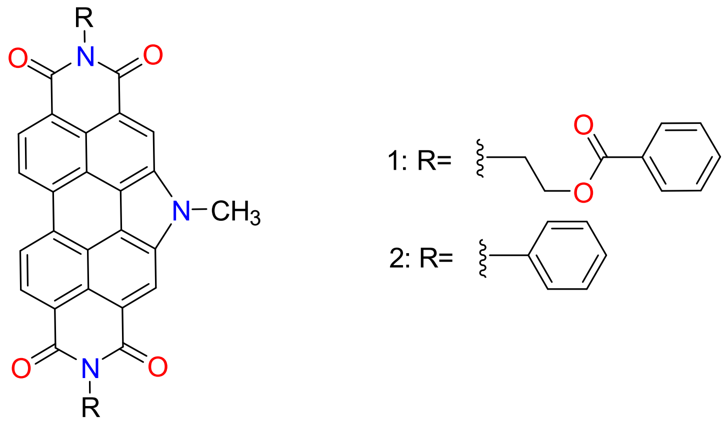

**Figure 1.** Chemical structure of the PBI derivatives.

## References

[1] Guo, Z.; Zhang, X.; Wang, Y.; Li, Z. *Langmuir* **2019**, *35*, 342–358.
[2] Chal, P.; Shit, A.; Nandi, A. K. *ChemistrySelect* **2018**, 3, 3993–4003.
[3] Greciano, E. E.; Calbo, J.; Ortí, E.; Sánchez, L. *Angew. Chemie - Int. Ed.* **2020**, 59, 17517–17524.

# Exploiting tetrazine tags to enrich pore complexity: from pyridazine networks to fulleretic materials

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Post-synthetic modification (PSM) is a widely used method to introduce new functional groups in reticular solids. The modification of organic and/or inorganic components offers appealing opportunities for the implementation of new chemical functionalities, many of which are not accessible by direct synthesis. Covalent PSM generally requires adequate chemical tags in the linkers for covalent functionalization, these motifs have been mainly focused on amino, aldehyde or alkyne groups. However, tetrazine tags represents an excellent alternative. This molecule can act as electron-poor diene in inverse Electron-Demand Diels-Alder (iEDDA) reactions which do not require a catalyst, offer fast kinetics, orthogonality, quantitative transformations under mild conditions, and inoffensive side products (N2). In this regard, the recently reported UiO-68-TZDC (TZDC = 4,4'-(1,2,4,5-tetrazine-3,6-diyl)dibenzoic acid) represents an ideal platform to implement this reactivity to tailor the pore environment.[1] A general post synthetic functionalization protocol enables to introduce a broad scope of alkene/alkyne dienophiles (fused rings, hydroxy groups, phenyl rings, succinimide, carboxylic terminated groups, aliphatic chains) leading multiple pore environments with diverse chemical functionalities in UiO-68-PZDC derivates.[2] The high degree of versatility of this route is reflected by the introduction of the $C_{60}$ molecule into the backbone. Synthesis of UiO-68-PZDC-$C_{60}$ overcomes intrinsic restrictions of time-consuming $C_{60}$ derivatization and the limited solubility of these molecules in the synthetic conditions conventionally used in MOF chemistry. In this regard, UiO-68-PZDC-$C_{60}$ represents one of the few of highly fulleretic 3D porous frameworks. Besides, the tetrazine coordination offers the possibility of studying the influence over the iEDDA reactivity of the nanostructured diene, which is not accessible in conventional organic-chemistry experiments. Direct comparation of the reactivity of nanostructured tetrazines in UiO 68-TZDC versus the free organic ligand proved the beneficial effects on the reactivity of the reticulation even though diffusion process. Given these results, UiO-68-TZDC seem to be excellent platforms to implement the "click" reactivity which opens the doors toward biological applications such as bioconjugation of enzymes to reticular solids.

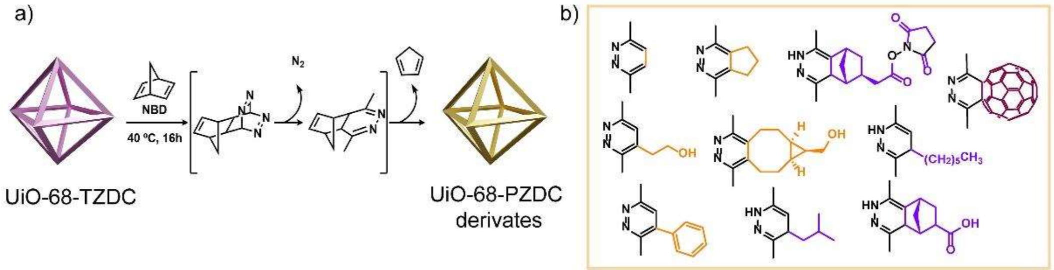

**Figure 1.** a) Scheme of the iEDDA Mechanism of the reaction between UiO-68-TZDC and NBD. b) Dienophile´s scope.References

[1] B. Lerma-Berlanga, C. R. Ganivet, N. Almora-Barrios, S. Tatay, Y. Peng, J. Albero, O. Fabelo, J. González-Platas, H. García, N. M. Padial, C. Martí-Gastaldo, *J Am Chem Soc.* **2021**, 143, 1798–1806.
[2] B. Lerma-Berlanga, C.R. Ganivet, N. Almora-Barrios, R. Vismara, J. A. R. Navarro, S. Tatay, N.M. Padial, C. Martí-Gastaldo, *submitted*, **2022**.

# Batch and flow synthesis of $CeO_2$ nanomaterials using solid state microwave generators

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Microwave assisted synthesis in combination with flow synthesis offer an interesting approach to develop faster and more sustainable procedures for the preparation of homogeneous nanomaterials. Recently, solid state generators of microwaves have appeared as a tool with improved control of the potency and frequency. Cerium oxide, despite its excellent catalytic activity, has not been prepared before using solid state generators or microwave assisted flow chemistry. We report a procedure for the preparation of nanoparticulated $CeO_2$ under 2,45 GHz microwaves in only 30 seconds (Figure 1). The procedure has been tested in batch at pH 11 and 12 and diverse potencies, and the products characterised by TEM, XRD, DLS and $N_2$ adsorption-desorption isotherms. The materials are similar at the diverse pHs and potencies. They are composed of particles around 40 nm that aggregate as structures of around 100 nm XRD confirms the crystallinity of the $CeO_2$ material with a fluorite like structure. They are composed of particles around 40 nm that aggregate as structures of around 100 nm. The procedure has been successfully adapted to flow synthesis, obtaining materials with structure and properties equivalent to batch synthesis. The batch and flow materials offer peroxidase properties, opening the door to their use as ROS scavengers [1].

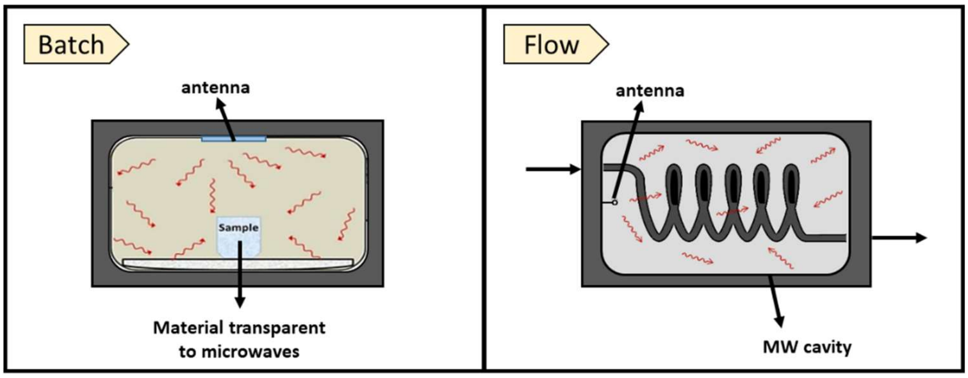

**Figure 1.** Scheme describing the setup for the microwave in batch and flow.

## Acknowledgments

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## References

[1] Rodríguez-Carrillo, C.; Torres García, J.; Benítez, M.; El Haskouri, J.; Amorós, P.; Ros-Lis, J.V. *Molecules* **2022**, 27, 2712.

# Metal-free asymmetric dearomatization of 2-nitrobenzofuranes via formal [3+2] cycloaddition reactions with isocyanoacetates

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Isocyanides are highly versatile synthons in organic synthesis due to their dual electrophilic and nucleophilic nature, which roots in the unusual valence of the carbon atom. Isocyanides also possess notable α-acidity, which can be increased when electron-withdrawing groups such as carboxylic esters, nitriles, sulfonyl groups or phosphoric esters are present. Carbanions generated via the deprotonation of isocyanides are able to take part in addition reactions to electrophilic double bonds. The resulting anion has inclination to attack the electrophilic carbon center of the isonitrile (−NC) moiety, thus yielding imine adducts.[1] These reactions are formally considered [3+2] cycloadditions.

Electron-deficient nitroheteroarenes, such as 2- and 3-nitroindoles,[2] and 2-nitrobenzofuranes,[3] have shown their potential as dipolarophiles in [3+2] reactions or dienophiles in [4+2] cycloaddition reactions, which are normally initiated by a Michael addition followed by intramolecular trapping of the anion by an electrophilic group.

In this communication, [3+2] cycloadditions between 2-nitrobenzofuranes and isocyanoacetate esters are carried out in an enantioselective and diastereoselective fashion, giving rise to the corresponding fused pyrrolines. A metal-free catalytic system comprised of an organocatalyst derived from cupreine has been employed for this procedure. Covering a wide scope, full diastereoselectivities and high enantioselectivities are obtained.

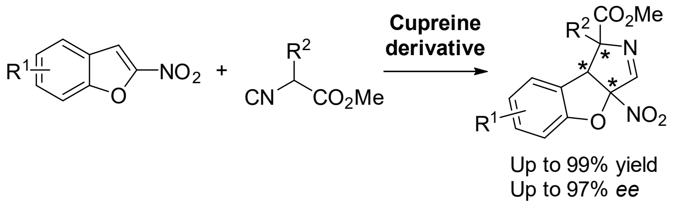

**Figure 1.** Dearomative formal [3 + 2] cycloaddition of 2-nitrobenzofuranes and isocyanoacetate esters

**Acknowledgments**
We acknowledge grant PID2020-116944GB-100 funded by MCIN/AEI/10.13039/501100011033 and by the "European Union Next Generation EU/PRTR", grant RyC-2016-20187 funded by MCIN/AEI/10.13039/501100011033 and by "ESF Investing in your future" to C.V., and grant FPU18/03038 funded by MEC to A.L. We acknowledge access to the NMR, MS, and X-ray facilities from the Servei Central de Suport a la Investigació Experimental (SCSIE)-UV.

**References**

[1] Blay, G.; Vila, C.; Martínez-Pardo, P.; Pedro, J. R. In *Targets in Heterocyclic Systems; Reviews and Accounts on Heterocyclic Chemistry*, vol. 22; Italian Society of Chemistry: Rome, **2018**; pp. *165−193.*
[2] Li, Y.; Tur, F.; Nielsen R. P.; Jiang, H.; Jensen, F.; Jørgensen, K.A. *Angew. Chem. Int. Ed.* **2016**, *55*, 1020.
[3] Wang, H.; Zhang, J.; Tu, Y.; Zhang, J. *Angew. Chem. Int. Ed.* **2019**, *58*, 5422.

# A new Zn-MOF used for catalysis and as supported to form Pd- and Ag-SACs

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Metal-organic frameworks (MOFs) are relatively new porous materials that are synthesized by binding organic ligands to metals. Thanks to their ultra-high surface area, well-defined structure, precise design ability and flexible adaptability, MOFs are used in many applications, such as gas storage, separation, drug delivery, or catalysis, to cite a few. As far as catalysis is concerned, this type of material can have catalytic activity due to: active sites located at metal nodes, at organic linkers or encapsulated metal particles inside the structure of Metal-Organic Frameworks. In the last 5 years, these materials have been shown to serve as a support for the obtention of single-atom catalysts (SACs), but the number of MOF-supported SACs that have been reported so far is very limited.[1] In this work, we present a novel environmentally-friendly MOF based on Zn, derived from the natural amino acid L-methyl cysteine, with formula $\{Ca^{II}Zn^{II}_6[(S,S)\text{-Mecysmox})_3(OH)_2(H_2O)\}\cdot 8H_2O$ (Mecysmox = [bis [(*S*)-mecystine]oxalyl diamide]) and its subsequent application as chemical nano-reactor for the formation of Pd- and Ag-SACs using post-synthetic methods. Interestingly, we were able to solve by single-crystal X-ray diffraction (SCXRD) the precise chemical structure of the Pd- and Ag-SACs@MOF, which unveiled unique snapshots of their stabilization, as well as accessible void space to perform specific catalytic reactions. These results presented show the possibility of supporting active metal sites on MOFs allowing not just their catalytic application in fine chemistry reactions, but also their reuse and recovery for potential industrial applications.[2]

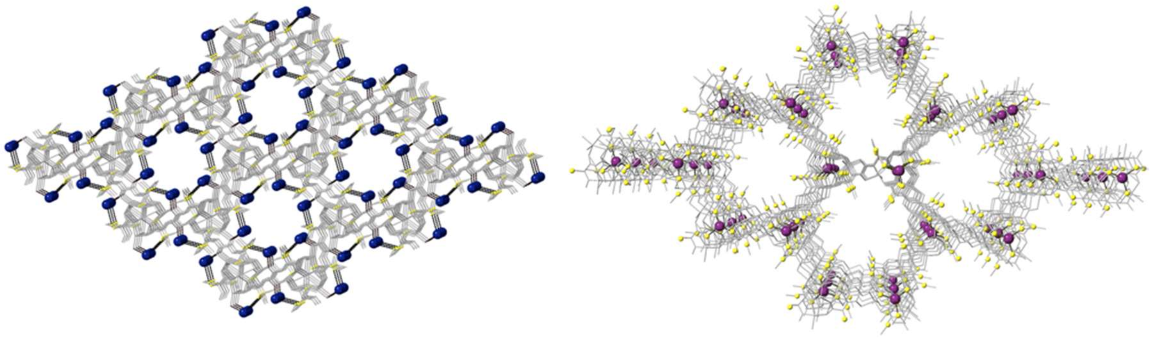

**Figure 1.** Perspective view along the c axes of Pd-SACs@MOF (left) and Ag-SACs@MOF (right). The framework is shown in grey, sulfur atoms of the ligand in yellow, palladium in blue and silver in purple.

## References

[1] Huang, H.; Shen, K.; Chen, F.; Li, Y. *ACS Catal.* **2020**, *10*, 6579-6586.

[2] Tiburcio, E.; Grecco, R.; Mon, M.; Ballesteros, J.; Ferrando-Soria, J.; López-Haro, M.; Hernández-Garrido, J.; Oliver-Meseguer, J.; Marini, C.; Boronat, M. et. al. *J. Am. Chem. Soc.* **2021**, *143*, 2581-2592.

# Contactless Passivation in MAPbBr3 Single Crystal

**Fernández Ismael***, **Noguera. Gomez. Jaume, Abargues. Rafa, F. Betancour. Pablo, Chyrvony Uladzimir, Pablo P. Boix***

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The unprecedented evolution of metal halide perovskite photovoltaics has been a key motivation to explore the outstanding optoelectronic properties of this family of materials. The research drive has focused mainly on compositional modifications and device structure improvements, but important factors such as the material stability are still important drawbacks for the technology. The use of monocrystalline material based on perovskite single crystals have been proposed to increase both efficiency and stability due to due the inherently low trap density defect of these materials that could represent an important leap in technology. However, the superior properties of monocrystalline perovskites are not directly translated into better device properties due to difficulties controlling the form factor and the surface defect densities. In this study we report a method to increase up to ten times the photoluminescence (PL) in methylammonium lead bromide (MAPbBr3) single crystals through suppression of non-radiative recombination. The contactless-passivation approach reported here could represent an alternate method for boosting the efficiency and stability of lead halide perovskites.

**Figure 1**. Optical image of Methylammonium lead bromide single crystal

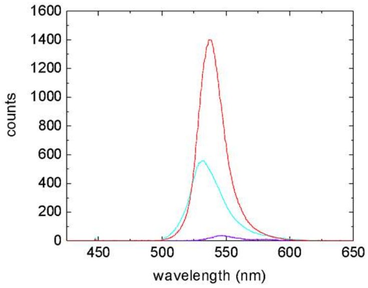

**Figure 2.** PL emission evolving in time of MAPbBr3 fresh single cristal (5 first minutes), PL emission during laser activation (shadow fill) and PL after laser activation (from minute

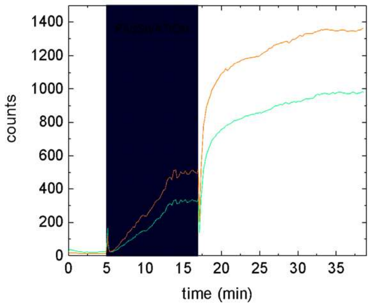

**Figure 3.** Characteristic emission bands in fresh crystal (purple line), during passivation (blue line) and after passivation (red line).

## References

[1] A decade of perovskite photovoltaics. Nat. Energy 4, 1–1 (2019).

[2] Giesbrecht, N. et al. Single-crystal-like optoelectronic-properties of MAPbI3 perovskite polycrystalline thin films. J. Mater. Chem. A 6, 4822–4828 (2018).

[3] Chen, Z. et al. Thin single crystal perovskite solar cells to harvest below-bandgap light absorption. J. Phys. Chem. Lett. 9, 1–6 (2018)

[4] Saidaminov, M. I. et al. High-quality bulk hybrid perovskite single crystals within minutes by inverse temperature crystallization. Nat. Commun. 6, 7586 (2015).

# Computational Study of the Reaction Mechanism and the Active Form of Human L-Asparaginase (hASNase3)

**M. Anđelković[1], J. J. Ruiz-Pernía[1], C. A. Ramos-Guzmán[1], K. Zinovjev[1], I. Tuñón[1*]**

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L-asparaginases (ASNases) are enzymes catalysing asparagine (Asn) hydrolysis reaction to aspartate and ammonia. Given the dependence of several haematological malignancies on extracellular asparagine, bacterial asparaginases are being widely used as a chemotherapeutic treatment. [1-2] However, in order to avoid the immune response and side effects of the bacterial enzymes, many experimental attempts have been made to replace enzymes of bacterial origin with mammalian enzymes such as human asparaginase type III (hASNase3)[3]. Despite substantial experimental work on the catalytic reaction, there are still controversies regarding the mechanism and no theoretical study has yet been done on hASNase3.

In this work we have studied the binding process and the reaction mechanism of hASNase3 by using a combination molecular dynamics simulations (MD), hybrid quantum mechanics/molecular mechanics (QM/MM), adaptive string method (ASM)[4] and free energy methods. Human ASNase3 is a homodimer with the active site residues originating from a single protomer. Therefore, in order to elucidate whether the dimer or the monomer are the physiologically relevant forms, both simulations of monomer and dimer structures were run.

First, due to the lack of a complete model of the enzyme, flexible loop was added by modelling using AlphaFold2[5]. Then alchemical free energy calculations were employed to determine the protonation state of the N-terminal group of Thr168, showing that the protonated state is predominant at experimental conditions but the deprotonated form is easily accessible. Analysis of classical MD simulations revealed that dimeric structure of hASNase3 is crucial for maintaining the substrate in the active site and its stability. Using a DFTB3/MM description, our results indicate that the reaction of acyl-enzyme formation starts with the activation of the nucleophile, the hydroxyl oxygen atom of Thr169, by its own N-terminal amino group acting as a base, followed by the nucleophilic attack and final proton transfer. The free energy barrier obtained for the formation of the acyl-enzyme intermediate is in good agreement with the experimentally-derived free energy barrier (16.9 kcal·mol$^{-1}$)[6].

Results found in this work did not only provide a theoretical basis for understanding the catalytic mechanism of hASNase3, the necessity of the dimeric structure and the cleavage process in order to liberate the terminal Thr168, but may also serve to guide further studies directed to improve the treatment of leukemia.

## Acknowledgments

The project that gave rise to these results received the support of a fellowship from "la Caixa" Foundation (ID 100010434). The fellowship code is LCF/BQ/DR21/11880026.

## References

[1] Broome. J. D. *J. Exp. Med.* **1963**, 118, 99-120
[2] Beard, M. E.; Crowther, D. et al. *Br. Med. J.*. **1970**, 5690, 191-195
[3] Schalk, A.M.; Nguyen, H. A. et al. *J. Biol. Chem.* **2014**, 289, 33175-33186
[4] Zinovjev, K.; Tuñón, I. *J. Phys. Chem. A*. **2017**, 121, 9764-9772
[5] Jumper, J.; Evans, R.; Pritzel, A. et al. *Nature*. **2021**, 596, 583–589
[6] J. Nomme, Y. Su, A. Lavie. *J. Mol. Biol.* **2014**, 426, 2471-2485

# Deciphering the biomedical performance of antimonene in correlation with is chemical evolution under biological conditions

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Two-dimensional (2D) materials have been ground-breaking in nanoscience due to their novel properties arising from their few-layered regime. Within 2D materials, the 2D-pnictogens (P, As, Sb, Bi) are very promising as a result of their unique electronic, magnetic and catalytic properties, among others.[1] Antimonene (AM) is a novel 2D monoatomic allotrope of antimony that shows a buckled honeycomb structure, with outstanding physical properties such as tuneable bandgap, high stability under ambient conditions, semiconductor–metal transitions or great photothermal conversion efficiency.[2, 3] Moreover, AM exhibits promising applications in biomedicine, and more specifically in biosensing, photothermal therapy and theragnostics. However, so far most of the studied AM materials exhibit poor quality in terms of morphology homogeneity, surface oxidation and particle size distribution, and they are difficult to obtain in large amounts. Interestingly, a new bottom-up protocol for the synthesis of high-quality AM hexagons based on colloidal chemistry has been recently reported.[4] In addition, this protocol can be optimized and scaled-up, as recently demonstrated by our group,[5] paving the way for the feasible biomedical application of AM. Nevertheless, the cytotoxic effects and the fate of bare AM within biological environments is poorly studied and never carried out for the novel AM hexagons.

Herein, we show the first comparative results about the assessment of the biomedical performance of three AM bare nanomaterials . Moreover, we performed the first study of the chemical evolution of the AM in biological conditions, allowing to relate the changes suffered by the AM in those conditions with the cytotoxic effects that produces. From our perspective, this will pave the way for the rational functionalization of AM, to enhance its biomedical performance in cancer treatment such as photothermal therapy or as drug delivery vehicles.[1]

## References

[1] Carrasco, J.A., Assebban, M., Congost-Escoin, P., Abellan, G. Chemistry of Antimonene: Understanding the next-generation 2D materials. *Chem Soc Rev* (submitted)

[2] Ares, P., Palacios, J. J., Abellán, G., Gómez-Herrero, J., and Zamora, F. Recent Progress on Antimonene: A New Bidimensional Material. *Adv. Mater.* **2018,** 30, 1703771.

[3] Fickert, M., Assebban, M., Canet-Ferrer, J., Abellán, G. Phonon properties and photo-thermal oxidation of micromechanically exfoliated antimonene nanosheets. *2D Mater.* **2020**, 8, 015018.

[4] Peng, L., Ye, S., Song, J., and Qu, J. Solution-Phase Synthesis of Few-Layer Hexagonal Antimonene Nanosheets via Anisotropic Growth. *Angew. Chem.* **2019** 131, 9996–1000.

[5] Torres, I., Alcaraz, M., Sanchis-Gual, R., Carrasco, J. A., Fickert, M., Assebban, M., Gibaja, C., Dolle, C., Aldave, D. A., Gómez-Navarro, C., Salagre, E., García, E., Varela, M., Gómez-Herrero, J., Abellán, G., Zamora, F. *Adv. Funct. Mater.* **2021,** 31, 2101616.

# Asymmetric organocatalytic arylation of isoxazolin-5-ones with *ortho*-benzoquinone diimides

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The considerable importance of α-arylated carbonyl compounds, which are widely used as final products or as key intermediates in the pharmaceutical industry,[1] has prompted numerous research groups to develop efficient synthetic strategies for their preparation in enantioselective fashion. In this context, the catalytic α-arylation of carbonyl enolates has been particularly helpful in constructing this motif.[2] Among arylating reagents, quinone and benzoquinone have been successfully used under organocatalytic conditions. However, the related ortho-benzoquinone diimides have never been used in arylation reactions, although they have displayed heterodiene behaviour in enantioselective hetero-Diels-Alder reactions.[3]

On the other hand, the isoxazolin-5-one framework can be found as a structural constituent of many natural products and bioactive compounds. Accordingly, the development of new procedures for the synthesis of chiral derivatives of these heterocycles is of great interest for organic chemists.[4] In this communication, we will report our results on the organocatalytic enantioselective arylation of isoxazolin-5-ones with ortho-benzoquinone diimides. The reaction provides the corresponding chiral isoxazolin-5-ones bearing an arylated quaternary stereocenter with good to excellent yields and enantiomeric excesses.

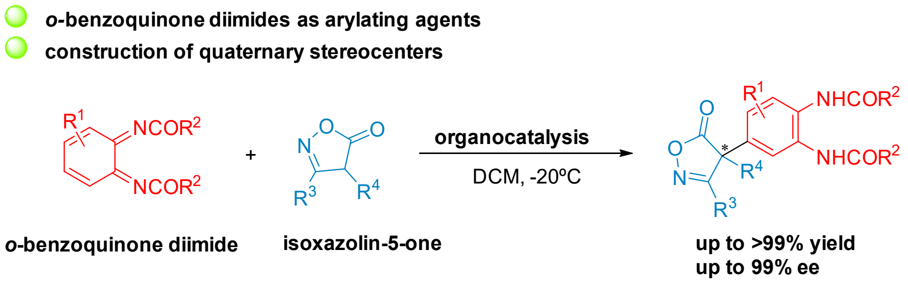

**Figure 1.** Organocatalytic enantioselective arylation of isoxazolin-5-ones with *ortho*-benzoquinone diimides.

## Acknowledgments

Grant PID2020-116944GB-100 funded by MCIN/AEI/ 10.13039/501100011033 and by the "European Union Next Generation EU/PRTR". Grant RyC-2016-20187 funded by MCIN/AEI/ 10.13039/501100011033 and by "ESF Investing in your future" to C. V., and grant Atracció de Talent INV19-01-13-09 funded by Universitat de València to R. T.

## References

[1] Hegde, V. R.; Puar, M. S.; Dai, P.; Patel, M.; Gullo, V. P.; Chan, T.-M.; Silver, J.; Pramanik, B. N.;. Jenh, C.-H.; *Bioorg. Med. Chem. Lett.* **2003**, *13*, 573.
[2] Hao, Y.-J.; Hu, X.-S.; Zhou, Y.; Zhou, J.; Yu, J.-S.; *ACS Catal.* **2020**, *10*, 955.
[3] Huang, R.; Chen, X.; Mou, C.; Luo, G.; Li, Y.; Li, X.; Xue, W.; Jin, Z.; Chi, Y. R.; *Org. Lett.* **2019**, *21*, 4340-4344.
[4] Da Silva, A. F.; Fernandes, A. A. G.; Thurow, S.; Stivanin, M. L.; Jurberg, I. D.; *Synthesis* **2018**, *50*, 2473-2489.

# Low-demanding in-situ crystallization method for tunable and stable perovskite nanoparticle thin-films.

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Metal halide perovskite nanocrystals can display excellent light emission properties, leveraging the chemical versatility of this family of materials.[1] However, using these features in functional films is an elusive task due to aggregation and material instability problems.[2] Using a metal-organic host matrix based on a sol-gel approach [3] allows for a controlled in-situ crystallization of perovskite nanocrystals (PNCs) with extremely low-demanding fabrication methods. As a result, this ambient annealing-free process generates high-performance nanocomposite thin films with PLQY>80% with outstanding ambient and mechanical stability. The crystallization dynamics determining the final nanoparticle size, and thus the emission properties, can be adjusted in detail through the ambient exposure and precursor concentration.

This in-situ PNCs nanocomposite synthesis approach (currently patent pending) may form the basis for the fabrication of large-area optoelectronic devices with enhanced properties, but also a groundwork on direct bandgap tunability through PNCs size's crystallization dynamics control.

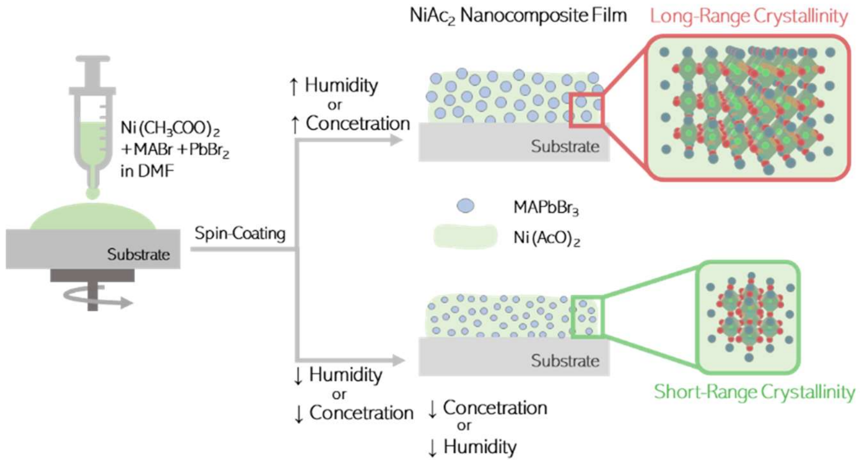

**Figure 1.** Example of illustration (Style: Times New Roman, 10 pt)

## Acknowledgments

J.N.G. acknowledge his FPU PhD contract with reference FPU19/04544.

## References

[1] Dey, A. et al. State of the Art and Prospects for Halide Perovskite Nanocrystals. *ACS Nano* **15**, 10775–10981 (2021).
[2] Akkerman, Q. A., Rainò, G., Kovalenko, M. V. & Manna, L. Genesis, Challenges and opportunities for colloidal lead halide perovskite nanocrystals. *Nat. Mater*. **17**, 394–405 (2018).
[3] Noguera-Gómez, J. et al. Solution-Processed Ni-Based Nanocomposite Electrocatalysts: An Approach to Highly Efficient Electrochemical Water Splitting. *ACS Appl. Energy Mater*. **4**, 5255–5264 (2021).

# Multivariate Metal-Organic Framework as a potential mimicker of active site of enzymes

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Natural enzymes stand out for their reactivity, selectivity and the ability to speed up reactions. In this study, we focus on Multivariate Metal-Organic Frameworks (MTV-MOFs) to construct mimics of the active centers of enzymes, and eventually, emulate the bioenzymatic catalytic processes that take place in natural enzymes. In this context, the channels of each MTV-MOF represent a unique and singular environment and offer unprecedented opportunities.[1] In this work, a previous reported MTV-MOF $\{Sr^{II}Cu^{II}_6[(S,S)\text{-methox}]_{1.50}[(S,S)\text{-Mecysmox}]_{1.50}(OH)_2(H_2O)\}. 36{\cdot}H_2O$[2] (**1**) has been used as chemical nano-reactor to construct mimics of active centers of enzymes. 1 shows hexagonal channels, where both types of amino acid residues derived from α-amino acids, L-methionine and L-Methylcysteine, coexist. This confers **1** with adequate physico-chemical properties to be used as host of bioenzymatic catalytic processes. In particular, the aim of this study is to build a complex that mimics the ones found in Fe hydrogenase enzymes through the post-synthetic (PS) incorporation of an iron complex, triirondodecacarbonyl ($Fe_3(CO)_{12}$). This PS process has been carried out under inert conditions ($N_2$ atmosphere). Single-cristal X-Ray Diffraction (SCXRD) has been used as a basic characterization technique and shows the coupling of the iron atoms within the channels of the MTV-MOF, which is a promising result to act as hosts of bioenzymatic catalytic processes.

## References

[1] Fracaroli, A. M.; Siman, P.; Nagib, D. A.; Suzuki, M.; Furukawa, H.; Toste, F. D.; Yaghi, O. M. *J. Am. Chem. Soc*. **2016**, *138 (27)*, 8352–8355.
[2] Negro, C.; Martínez Pérez-Cejuela, H.; Simó-Alfonso, E. F.; Herrero-Martínez, J. M.; Bruno, R.; Armentano, D.; Ferrando-Soria, J.; Pardo, E. *ACS Appl. Mater. Interfaces* **2021**, *13 (24)*, 28424–28432.

# Conductivity enhancement in a perylene-based MOF via iodine doping: A theoretical insight.

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Metal-organic frameworks (MOFs) are crystalline porous materials built from organic ligands and metallic nodes, which have experimented exponential scientific interest in the last decade due to their extraordinary chemical and structural versatility.[1] In addition to their exploitation in classical applications such as gas separation/storage and catalysis, electrically conductive MOFs have appeared in the recent years as promising materials for next-generation applications in the fields of optoelectronics, energy storage and conversion, among others.[2,3] One of the most common strategies employed in the design of conductive MOFs consist in the use of electroactive organic ligands and their partial oxidation/reduction to increase charge carrier concentration.[4] Most perylene-based MOFs have been studied towards gas sorption and sensing applications due to the remarkable luminescence properties of perylene.[5] However, despite being reported as the first molecular conductors,[3] perylene units have been scarcely considered as building blocks for conductive MOFs.

Herein, we present a theoretical study on the electronic, conducting, and optical properties of a perylene-based MOF (**Per-MOF**) (Figure 1), formed by a herringbone packing of 3,4,9,10-perylenetetracarboxylate (PTC) ligands with potassium ions. Encouraged by the experimental evidence, DFT-level calculations were performed on the undoped and $I_2$-doped **Per-MOF** to shed light on the conductivity enhancement exhibited by the material upon iodine inclusion. This increase in the charge transport properties upon $I_2$-doping is rationalized by the spontaneous formation of PTC radical cation, which results from the oxidation of the perylene motif by $I_2$ and leads to the formation of $I_3^-$ species. The charge transport in the semiconducting $I_2$-doped **Per-MOF** is described in terms of a through-space hopping mechanism along the herringbone PTC packing, where the communication between perylene units is boosted by the electronic participation of $I_2/I_3^-$.

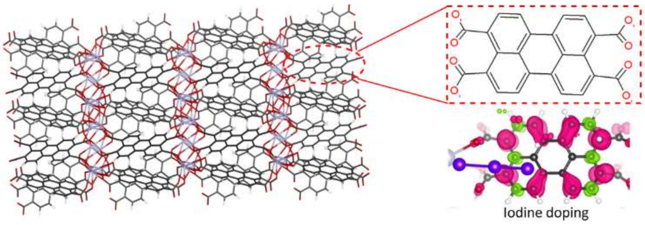

**Figure 1.** Herringbone arrangement of the PTC linkers (left), PTC ligand (upper right) and spin density after iodine doping (lower right). Grey, red, violet, and purple colours represent carbon, oxygen, potassium, and iodine atoms, respectively.

## References

[1] Dincă, M.; Long, J. R. *Chem. Rev.* **2020**, *120*, 8037-8038.
[2] Allendorf, M. D.; Dong,R.; Feng, X.; Kaskel, S.; *et al. Chem. Rev.* **2020**, *120*, 8581-8640.
[3] Souto, M.; Strutyński, K.; Melle-Franco, M.; Rocha, J. *Chem. Eur. J.* **2020**, *26*, 10912-10935.
[4] Xie, L. S.; Skorupskii, G.; Dincă, M. *Chem. Rev.* **2020**, *120*, 8536-8580.
[5] Seco, J. M.; San Sebastián, E.; Cepeda, J.; *et al. Sci. Rep.* **2018**, 8, 1-10.

# A chemometric strategy to distinguish among roman pigments using colorimetric data

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Roman *frescoes* are one of the most characteristic features in their architectural legacy. Commonly used to decorate the insides of their buildings, their manufacturing was a science in itself: from the surface preparation to the application of the different pigments to obtain a palette of hues and intensities.

Nowadays, as some of these pictorial art pieces have been conserved, their analysis has become of great importance in the Cultural Heritage field. To it, different non-destructive analytical techniques are usually used, providing with different information: elemental composition is determined using p-XRF and Raman spectroscopies, and the presence of organic components and some inorganic species is addressed using FTIR spectroscopy.

In this context, the present work describes the application of chemometric strategies (LDA, SVC and kNN classifiers) to identify three different red roman pigments in *frescoes* mock-ups based on image parameters. Hematite, minium, cinnabar and different mixtures of those were chosen due to their importance in the roman world. A colorimetric characterization of the replicas was carried out using a smartphone and a spectrocolorimeter, and the results compared between them to assess the validity of the smartphone data. Also, they were analyzed using the standard techniques: p-XRF, Raman and FTIR.

Color features were correlated with the elemental composition to understand its influence on the color changes. Then, three classificatory methods were built using CIE L*a*b* data obtained with the smartphone, and the errors of predictions were compared among them, to prove that LDA and SVC worked more efficiently to correctly identify the different pigments. More specifically, the models yielded 8.70 % and 6.80 % errors of predictions, respectively.

All in all, this work shows the potential of smartphones as analytical devices in the field of Cultural Heritage, since they are readily available, easy to use, and have a low cost.

**Acknowledgments**
Roberto Sáez-Hernández thanks the Ministry of Universities of Spain for a FPU predoctoral position (FPU19/02304). This research has been founded by the Generalitat Valenciana – Conselleria d'Innovació, Ciència i Societat Digital through PROMETEO-2019-056.

# Incorporation of Gold Nanoparticles in Titanium-Organic Frameworks by dynamic methodologies

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Metal-Organic Frameworks (MOFs) are a relative new class of crystalline, highly porous materials consisting on organic linkers and inorganic metal centres held together by coordinative bonds to form three-dimensional structures with periodic order. The porosity within their structure and their diverse nature of metal nodes gives them a wide chemical range of applications such as gas adsorption, toxics removal, sensing or photocatalysis, among others [1].

In particular, Titanium (IV) based MOFs have attracted a lot of attention due to their high chemical stability and Ti lows toxicity. However, only classic MOFs solvothermal methodologies have been described for the synthesis of these compounds obtaining amorphous titanium oxide particles as a secondary product [2].

Herein, we describe a novel dynamic synthetic method for Ti (IV) MOFs, where homogeneous MUV-10 has been obtained in lesser time than classic solvothermal methodologies plus preserving the same physico-chemical properties as classic MUV-10 [3]. Furthermore, this new methodology sets up an innovative way of functionalizing MOFs with different external species, such as nanoparticles (NPs), by injecting them at various punctual stages in the synthetic procedure and, that way, controlling the spatial distribution of those species along the periodic structure of the MOF. Inspired by previous works of metal nanoparticles encapsulation in MOFs,[4] we have successfully functionalized MUV-10 with spherical gold NPs at different sites among the crystalline porous material without altering their crystallographic or chemical properties. Given the well-known catalytic properties of gold nanoparticles these brand-new composites present very promising applications as a robust catalyst where not only the framework acts as capping protecting the NPs but also the catalytic efficiency would be directly dependent on the spatial location of the NP within the MOF [5].

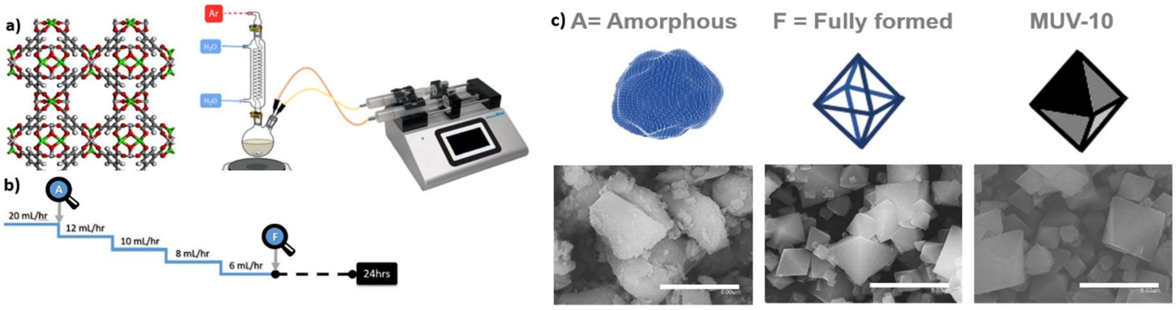

**Figure 1.** (a) Structure of MUV-10 and dynamic set-up; (b) dynamic synthetic conditions highlighting the injection points of Au NPs; (c) SEM images of the formation of the MOF during the different stages.

## References

[1] Furukawa, H.; Cordova, K.E.; O'Keffe, M.; Yaghi, O.M. *Science,* **2013**, *341,* 1230444, 974-986.
[2] Assi, H.; Mouchaham, G.; Steunou, N.; Devic, T.; Serre, C. *Chem Soc. Rev.,* **2017**, *46,* 3431-52.
[3] Castells-Gil, J.; Padial, N.M.; Almora-Barrios, N.; Alvero, J.; Ruiz-Salvador, A. R.; González-Platas, J.; García, H.; Martí-Gastaldo, C. *Angew. Chem.,* **2018,** *130,* 8589-8593.
[4] Lu, G. et al. *Nature Chemistry,* **2012**, *4,* 310-316.
[5] Corma, A.; García, H., *Chem. Soc. Rev.,* **2008**, *37,* 2096-2126.

# Decomposition mechanism of the dioxetane derivate of the melanin DHICA-DO: A theoretical study

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It is well known that our skin is protected against UV radiation by the pigment melanin. However, in recent years an obscure role of this pigment has been discovered. It has been suggested that chemiexcitation (chemical electronic excitation) is responsible for the production of melanomas when there is no UV radiation. The source for this type of excitation process is a dioxetane derivate of the melanin monomer 5,6-dihydroxyindole-2-carboxylic acid (DHICA-DO, Figure 1), whose decomposition induces the formation of dimerizations in the DNA pyrimidine bases[1]. In this work, we have carried out a theoretical study to determine the molecular basis of the mentioned process.

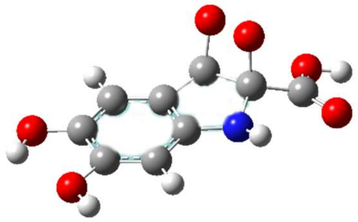

**Figure 1.** Optimized geometry of the ground state of the chemiexcitator DHICA-DO.

Firstly, we have studied the mechanism of the decomposition of dioxetane, using two different conformers of the chemiexcitator proposed by Premi and co-workers[1]. In both cases, the mechanism goes through a diradical intermediate that allows to populate the triplet excited state[2] making plausible the chemiexcitation process. Secondly, we have constructed many aggregates formed by a nucleobase and the most stable conformer of the DHICA-DO, to study how the mechanism is affected by the presence of the DNA base. We have analysed in this context different factors which can be relevant such as the ionization potential of the nucleobases, the formation of hydrogen bonds, the spin density delocalization and the presence or absence of $\pi$-stacking interactions.

## References

[1] Premi, S.; Wallisch, S.; Mano, C. M.; Weiner, A. B.; Bacchiocchi, A.; Wakamatsu, K.; Bechara, E. J. H.; Halaban, R.; Douki, T.; Brash, D. E. Photochemistry. Chemiexcitation of Melanin Derivatives Induces DNA Photoproducts Long after UV Exposure. *Science*. **2015**, *347* (6224), 842–847.

[2] Farahani, P.; Roca-Sanjuán, D.; Zapata, F.; Lindh, R. Revisiting the Nonadiabatic Process in 1,2-Dioxetane. *J. Chem. Theory Comput*. **2013**, *9 (12)*, 5404–5411.

# Development of the diastereoselective cross metathesis/cycloaromatization/Pictet-Spengler one pot reaction [1]

**D. Gaviña**[1], **M. Escolano**[1], **M. Sánchez-Roselló**[1], **C. del Pozo**[1*]

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The first example of a tandem cycloaromatization [2] /Pictet Spengler has been described with good levels of diastereoselectivity. This reaction gives access to a new family of polycyclic pyrrole derivatives, a very interesting scaffold for the pharmaceutical industry, with the formation of a quaternary stereogenic centre in a single reaction step.

The key step for the synthesis of the substrates was the cross metathesis of terminal olefins derived from amino acids and alkyl vinyl ketones. Furthermore, the tandem reaction was accomplished with good results after the cross metathesis in a "one pot" sequence. The amino acid-derived substrates were employed as a mixture of diastereoisomers as both of them convert to the same iminium ion intermediate by dehydration.

The reaction, which takes place in presence of one equivalent of p-toluenesulfonic acid, was achieved with moderate to good yields and with good to complete diastereoselectivity. This methodology allows a wide scope, as is it possible to modify both aromatic rings and both stereogenic centers.

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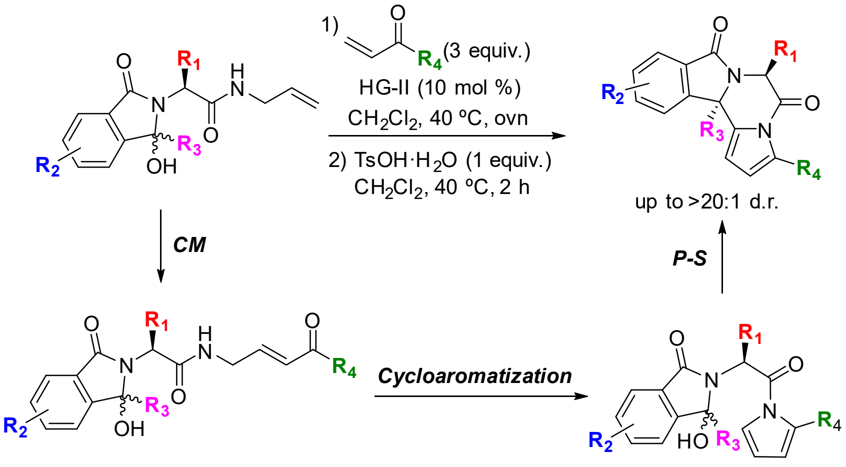

**Figure 1.** Cross metathesis/cycloaromatization/Pictet-Spengler diastereoselective "one pot" sequence to obtain polycyclic pyrrole derivatives

## References

[1] Rabasa-Alcañiz, F.; Sánchez-Roselló, M.; Fustero, S.; del Pozo, C. J. Org. Chem. 2019, 84, 10785–10795.
[2] Donohoe, T. J.; Race, N. J.; Bower, J. F.; Callens, C. K. A. *Org. Lett.* **2010**, *12*, 4094–4097.

# A superoxide dismutase mimetic nanozyme with outstanding antioxidant activity

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Misregulation of free metal ions and oxidative stress have been linked to the progressive neurological misfunction associated with multiple neurodegenerative disorders. For instance, in Alzheimer's disease, accumulation of Fe, Cu and Zn in beta-amyloid plaques have proved responsible for increased oxidative injury in certain brain regions. These transition metals mediate in the production of Reactive Oxygen Species (ROS) via Fenton chemical reactions, among which superoxide radicals play a prevailing role. Finally, the imbalance between the generation and scavenging of ROS derives in oxidative stress. Current therapy research for these disorders is aimed at interfering with responsible metal ions and modifying their detrimental activity. [1]

A tetraaza-pyridinophane macrocycle (figure 1) capable of chelating ROS-producing metal ions has been synthesized and characterized. Potentiometric and UV-vis titrations, as well as electrochemical studies and SOD activity assays, have concluded that it can coordinate Fe(II) and Cu(II), leading to the formation of complexes with an outstanding Superoxide Dismutase (SOD) activity. [2,3]

This macrocycle has been designed with a para-carbonyl group in order to be grafted onto boehmite nanoparticles (BNPs). The corresponding amino-nanozyme system has been prepared and characterized. Same studies as with the unbonded Cu(II) complexes showed that being linked to BNPs induces a 30-fold increase in their SOD catalytic constant, probably due to the positive $\zeta$-potential of the functionalised nanoparticles. [4,5]

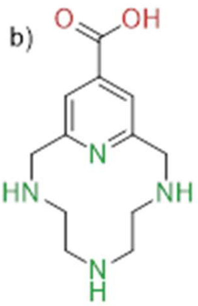

**Figure 1.** Synthesized tetraaza-pyridinophane macrocycle.

**References**

[1] K. M. Lincoln, P. Gonzalez, T. E. Richardson, D. A. Julovich, R. Saunders, J. W. Simpkins, K. N. Green, Chem. Commun., **2013**, 49, 2712-2714.

[2] A. Martínez-Camarena, A. Liberato, E. Delgado-Pinar, A. G. Algarra, Pitarch- Jarque, J. M. Llinares, M. A. Mañez, A. Domenech-Carbó, M. G. Basallote, E. García- España, *Inorg. Chem.*, **2018**, 57, 10961-10973.

[3] Lluís Guijarro, Mario Inclán, Javier Pitarch-Jarque, Antonio Doménech-Carbó, Javier U. Chicote, Sandra Trefler, Enrique García-España, Antonio García-España, Begoña Verdejo, *Inorg. Chem.*, **2017**, 56, 13748-13758.

[4] A. Martínez-Camarena, E. Delgado-Pinar, C. Soriano, J. Alarcón, J. M. Llinares, R. Tejero, E. García-España, *Chem. Commun.*, **2018**, 54, 3871-3874.

[5] Álvaro Martínez-Camarena, José M. Llinares, Antonio Domenech-Carbó, Javier Alarcón, Enrique García-España, *RSC Adv.*, **2019**, 9, 41549-41560.

# Retention behavior and enantioresolution with polysaccharide-based chiral stationary phases and hydroorganic mobile phases of basic and neutral structurally unrelated chiral compounds

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High-performance liquid chromatography (HPLC) in combination with chiral stationary phases (CSPs) is the preferential choice for the separation of the enantiomers of chiral compounds due to its simplicity and ruggedness [1]. Among the large number of commercially available CSPs, the amylose or cellulose polysaccharide derivatives are the most used due to their broad applicability [2,3]. Moreover, these CSPs are compatible with all mobile phase chromatographic regimes: apolar organic (normal phase HPLC), polar organic (polar organic HPLC), and hydroorganic (RPLC: reversed phase HPLC, and HILIC: hydrophilic interaction liquid chromatography) [4].

In this communication, a comparative study on the retention behavior and enantioresolution of 55 structurally unrelated basic and neutral compounds using five cellulose- (Cell1: cellulose tris (3,5-dimethylphenylcarbamate); Cell2: cellulose tris(3-chloro-4-methylphenylcarbamate); Cell3: cellulose tris(4-methylbenzoate); Cell4: cellulose tris(4-chloro-3-methylphenylcarbamate) and Cell5: immobilized cellulose tris(3,5-dichlorophenylcarbamate)) and three amylose-based CSPs (Am1: amylose tris(3,5-dimethylphenylcarbamate); Am2: amylose tris(5-chloro-2-methylphenylcarbamate) and Am3: immobilized amylose tris(3-chloro-5-methylphenylcarbamate)) is performed. Mobile phases consist of binary mixtures of methanol (30-90% MeOH) or acetonitrile (10-98% ACN) with 5 mM $NH_4HCO_3$ (p$H$ = 8.0). The existence of RPLC and HILIC retention behavior domains is explored. The effects of the nature and concentration of the organic solvent used in the mobile phase, the nature and positions of the substituents on the CSP, as well as of the polysaccharide backbone on the retention and the enantioresolution are also studied.

**Acknowledgements**
Mireia Pérez Baeza acknowledges to Generalitat Valenciana and European Social Fund for the contribution to the contract ACIF/2019/158.

## References

[1] Teixeira, J. *Molecules* **2019**, *24*(5), 865.
[2] Padró, J.M. *Microchem. J.* **2018**, *140*, 142–157.
[3] Chankvetadze, B. *J. Chromatogr. A* **2012**, *1269*, 26–51.
[4] Chankvetadze, B. *Trend. Anal. Chem.* **2020**, *122*, 115709.

# Coordination and removal of heavy metal ions by boehmite macrocyclic polyamines.

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The synthesis, acid–base behaviour and heavy metal (Hg(II), Cd(II), Pb(II)) coordination chemistry of the hexaaazacyclophane ligand (14-hydroxy-3,7,11,14,18,22-hexaaza-1(2,6)-pyridinacyclotricosaphane, L1) have been studied by potentiometric, NMR and UV-Vis techniques. Protonation studies reveal that deprotonation of the pyridinol moiety gives rise to a keto-enolic equilibrium, which justifies the higher protonation constant values compared with those analogous pyridine receptors. Coordination chemistry studies reveal the formation of mono and binuclear species above pH 5, highlighting the formation of mostly mononuclear species in the case of Cd(II). The macrocycle has been supported in boehmite nanoparticles for facilitating the metal ion excavenging.

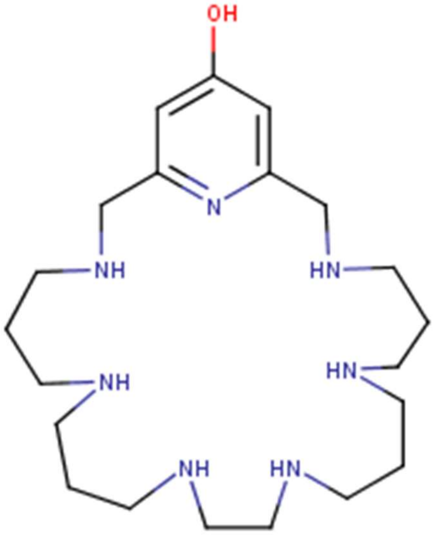

**Figure 1.** Structure of ligand L1

**Acknowledgments**

Financial support by the Spanish Ministerio de Economía y Competitividad (Projects CTQ2017-90852-REDC, RED2018-102331-T, PID2019-110751RB-I00 and Unidad de Excelencia CEX2019-000919-M).

**References**

[1] Martínez-Camarena, Á., Llinares, J. M., Domenech-Carbó, A., Alarcón, J., & García-España, E. A step forward in the development of superoxide dismutase mimetic nanozymes: The effect of the charge of the surface on antioxidant activity. RSC Adv., **2019**, 9, 41549–41560.

[2] Martínez-Camarena, Á., Delgado-Pinar, E., Soriano, C., Alarcón, J., Llinares, J. M., Tejero, R., & García-España, E. Enhancement of SOD activity in boehmite supported nanoreceptors. Chem. Commun, **2018**, 54, 3871-3874.

[3] J. E. Richman and T. J. Atkins, J. Am. Chem. Soc., **1974**, 96, 2268.

# BioMOFs as Environmental Remediation: a Highly and Efficient Removal of Insecticides

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Tackling the increasing impact of agrochemicals on aquatic environments has become a necessity for health and ecological reasons. Herein, we report the use of eco-friendly water-stable isoreticular MOFs as adsorbents for the removal of neonicotinoid insecticides from water.[1] In particular, the novel multivariate MOF $\{Sr^{II}Cu^{II}_6[(S,S)\text{-methox}]_{1.5}[(S,S)\text{-Mecysmox}]_{1.50}(OH)_2(H_2O)\}\cdot 36H_2O$ (**5**) exhibits the higher removal efficiency, capturing 100% of acetamiprid and thiacloprid (Figure 1) in a single capture step under dynamic solid-phase extraction conditions –less than 30 seconds. Such unusual outstanding efficiency, high stability in environmental conditions, and low-cost straightforward synthesis in **5**, place this material among the most attractive adsorbents reported for the removal of this type of contaminants.

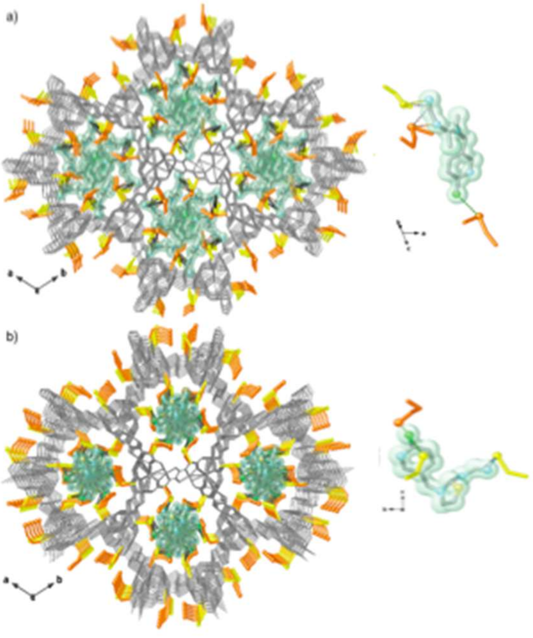

**Figure 1**. Perspective views of acetamiprid@5 (a) and thiacloprid@5 (b)

**References**

[1] Mon, M.; Lloret, F.; Ferrando-Soria, J.; Martí-Gastaldo, C.; Armentano, D.; Pardo, E. Selective and Efficient Removal of Mercury from Aqueous Media with the Highly Flexible Arms of a BioMOF. *Angew. Chemie Int. Ed.* 2016, *55* (37)

# A Theoretical Insight on the Diradical Character of Dicyanomethylene π-Conjugated Compounds

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Organic diradicals present a wide range of potential for numerous advanced technological applications due to their unique electrical, optical and magnetic properties. [1] Owing to their stability remains the major obstacle, the object of many experimental and theoretical studies is the design and synthesis of stable ground-state open-shell molecules. A very efficient strategy to stabilize the diradical species is the insertion of terminal electron-withdrawing dicyanomethylene (DCM) groups in a π-conjugated skeleton. An interesting family of π-conjugated systems with diradical character is formed by quinoidal oligothiophenes (QTs) with terminal DCM groups.[2] These QTs behave as organic semiconductors and they have been successfully implemented as active components in organic field-effect transistors (OFETs).

From a theoretical standpoint, the description and characterization of the electronic structure of organic diradicals (or polyradicals) is a difficult task that generally requires the use of accurate but computationally-demanding multiconfigurational methods due to their unpaired electrons. Among the available multiconfigurational methods, the Difference Dedicated Configurational Interaction (DDCI) method[3] is able to treat diradical organic systems with an affordable computational cost. Herein, a series of conjugated systems that combine thiophene and benzene rings with end-capping dicyanomethylene groups (Figure 1) is evaluated by means of DDCI method to predict accurate singlet-triplet energy gaps, which is important for the design of new diradical compounds.

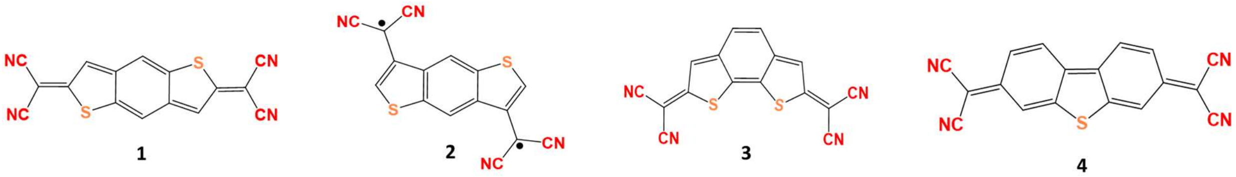

**Figure 1.** Chemical structures of the conjugated π-conjugated systems studied.

**References**

[1] Gallegher, N; Zhang, H.; Junghoefer, T.; Giangrisostomi, E.; Ovsyannikov, R.; Pink, M.; Rajca, S; Casu, M. B.; Rajca, A. *J. Am. Chem. Soc.* **2019**, *141*, 4764-4774.

[2] Ponce Ortiz, R.; Casado, J.; Hernández, V.; López Navarrete, J. T.; Viruela, P. M.; Ortí, E.; Takimiya, K.; Otsubo, T. *Angew. Chem. Int. Ed.* **2007**, *46*, 9057-9061.

[3] Suaud, N.; Ruamps, R.; Guihéry, N.; Malrieu, J.P. *J. Chem. Theory Comput.* **2012**, *8*, 4127-4137.

# Generalized “one-pot” preparative strategy to obtain highly functionalized silica-based mesoporous spherical particles

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In this work, we present a synthesis strategy for the preparation of Stöber-type mesoporous particles functionalized with inorganic species. The procedure is based on a combination of the Atrane and the Stöber methods. Both as a source of silicon and the incorporated heteroelements (Fe, Zn, Al, Ti) the corresponding atrane complexes are used as hydrolytic reagents. These complexes are easily formed by reaction with triethanolamine. Mesoporosity is achieved using surfactant micelles as templates. Obtaining uniform spherical particles is achieved by optimizing the amount of water-ethanol in the reaction medium. The particle sizes have been modulated by controlling simple parameters such as reaction time or temperature. The incorporation of inorganic species is on many occasions incompatible with the preservation of spherical morphology, resulting in heterogeneous particles in shape and size and even phase segregation for high functionalization degrees. The methodology used makes it possible to incorporate inorganic species in a high concentration and dispersed. Furthermore, the spherical morphology and particle size homogeneity are preserved to a large extent (Figure 1). The strategy is generalizable for the incorporation of a great variety of elements, especially for first-row transition elements. [1]

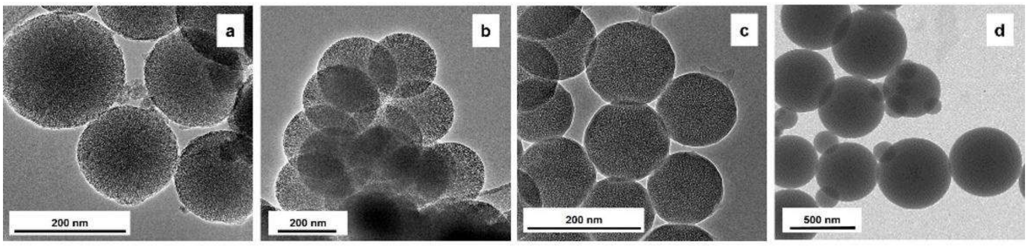

**Figure 1.** TEM images of mesoporous spherical silica particles dopped with a) iron, b) zinc, c) aluminum, and d) titanium

**Acknowledgments**
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## References

[1] Garrido, M. D.; El Haskouri, J.; Vie, D.; Beltrán, A.; Ros-Lis, J. V.; Marcos, M. D.; Moliner, N.; Amorós, P. Generalized “one-pot” preparative strategy to obtain highly functionalized silica-based mesoporous spherical particles. *Microporous Mesoporous Mater.* **2022,** *accepted.*

# Theoretical study on the photoinduced repair mechanism of (6-4) photoproduct DNA lesions using oxetane models

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The DNA in living beings is continuously damaged by both exogenous and endogenous agents, such as UV radiation, giving rise to lesions in the DNA. The most common lesions are cyclobutene pyrimidine dimers and (6-4) photoproducts. The photoinduced (6-4) photoproducts DNA lesions can be initiated by Paternò–Büchi photocycloaddition between two adjacent pyrimidine bases, forming an oxetane ring. Then, the repair mechanism of these lesions can be characterized by the inverted mechanism of the Paternò-Büchi reaction.

In this contribution, two types of oxetanes have been studied as model compounds of the elusive oxetane intermediate present during the (6-4) photoproducts repair. The first type of oxetane arise from the reaction between two benzoquinone molecules (BQ-ox). The second type, is formed by two naphthoquinone monomers, called NQ-1. These models have been compared with previous results obtained for two stable head-to-head and head-to-tail isomers (HH-1 and HT-1, respectively) formed by reacting dimethylthymine and benzophenone[1].

CASPT2//CASSCF and DFT calculations have allowed to interpret the experimental observations. In addition, they also help us to determine the properties of relevant intermediates. It has been observed that both BQ-ox and NQ-1 will decay to the ground state, without the formation of the triplet exciplex, while HH-1 points to a favourable evolution to a triplet exciplex in a much higher extent than HT-1[1]. These findings agree with the results obtained by our experimental collaborators.

## References

[1] Blasco-Brusola, A.; Navarrete-Miguel, M.; Giussani, A.; Roca-Sanjuán; D. Vayá, I.; Miranda, M. A. *Phys. Chem. Chem. Phys.* **2020**, *22,* 20037.

# Light-Driven Electrophilic Functionalization of Quinoxalin-2-ones

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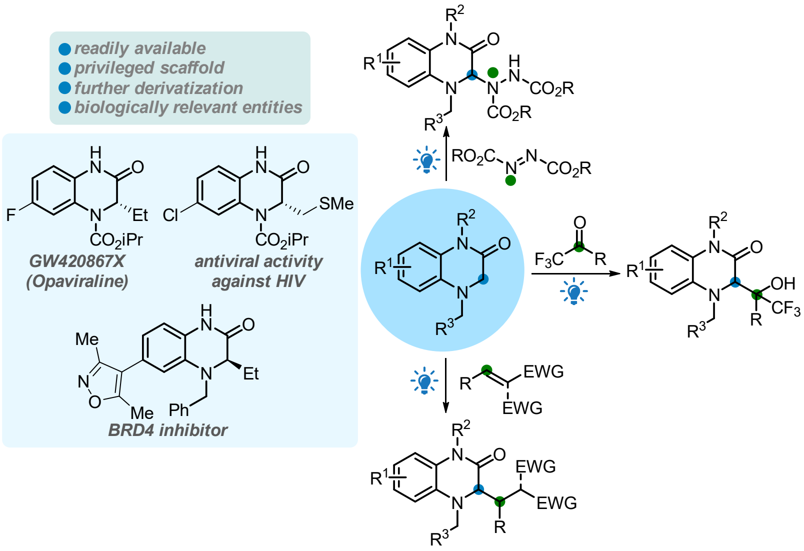
The use of visible light to trigger new synthetic transformations has been a hot topic since the last decade[1]. In this context, the skeleton of quinoxalin-2-one was considered for us as a privileged motif to explore some photochemical-based synthetic modifications, considering that it can also be found in several natural and synthetic biologically active compounds[2]. In this communication we are pleased to present our recent developments in the functionalization of quinoxalin-2-ones at its C-3 position with several electrophiles using visible light.

First, we show our efforts in the amination of quinoxalin-2-ones using dialkyl azodicarboxylates[3]. The reaction showed a rate increase while being irradiated and allowed us to obtain a collection of aminated quinoxalin-2-ones. Moreover, this newly forged C-N bond could be selectively cleavaged to prepare different derivatives.

Next, the radical 1,2-addition reaction of quinoxalin-2-ones to trifluoroacetophenones was found for us as a powerful tool to install a trifluoromethyl-containing tertiary alcohol in the C-3 position of quinoxalin-2-one[4]. The generality of this transformation was studied as well as the mechanism behind this transformation.

Finally, the same *C*-centered radical of quinoxalin-2-one used in the 1,2-addition was tested in 1,4-addition (namely Giese reaction)[5]. To our delight, the reaction exhibited high robustness and therefore it was applied to a vast assortment of electron-poor alkenes, even several derived from either natural or biologically active compounds. An exhaustive mechanistic analysis was also carried out, revealing a particular activation manner of quinoxalin-2-one toward Single Electron Transfer events.



## References

[1] MacMillan, D.W.C *et al. Chem. Rev*. **2013**, *113*, 5322–5363. [2] Li, X. *et al. Mini-Rev. Org. Chem.*, **2014**, *12*, 96. [3] Rostoll-Berenguer, J.; Capella-Argente, M.; Blay, G.; Pedro, J. R.; Vila, C. *Org. Biomol. Chem.* **2021**, *19*, 6250. [4] Rostoll-Berenguer, J.; Martín-López, M.; Blay, G.; Pedro, J. R.; Vila, C. *manuscript under preparation*. [5] Rostoll-Berenguer, J.; Blay, G.; Pedro, J. R.; Vila, C. *Org. Lett.* **2020**, *22*, 8012.

# Working mechanisms of photodetectors based on High a stable metal-halide perovskite nanocrystals composite with broad Frequency response

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Organic-inorganic hybrid perovskite exhibits outstanding properties in light emission and photovoltaic applications, exceeding conversion efficiencies of 25%, and fast photodetection response [1]. Thus, considering the size-dependent optical and electronic properties of these materials, the use of perovskite nanocrystals helps to mitigate bulk related issues such as photoinduced halide segregation and crystal phase instability [2]. However, some challenges still need to be addressed in terms of device fabrication, particle aggregation, annealing and post-treatment related issues, and environmental instability when assembled [3]. Therefore, using a metal-organic host matrix based on a sol-gel approach [4] as a straightforward method for the in-situ and controlled generation of highly stable perovskite nanocrystals (PNCs) stands out as a promising alternative. The optical and electrical properties of these materials are evaluated to enlighten the specific characteristics of this system concerning a perovskite polycrystalline thin film, showing photoluminescence quantum yield exceeding 80%, photocurrent response with an ON/OFF current ratio around two orders of magnitude, and remarkable stability over time when stored under room conditions.

We believe that our antisolvent and glovebox-free approach for the preparation of PNCs will pave the road for its application in perovskite photodetectors, among other devices as sensors, and light emitters.

### References

[1] M. Kim *et al.*, “Conformal quantum dot-SnO2 layers as electron transporters for efficient perovskite solar cells,” *Science (80-. ).*, vol. 375, no. 6578, pp. 302–306, Jan. 2022.
[2] M. Suri *et al.*, “Enhanced Open-Circuit Voltage of Wide-Bandgap Perovskite Photovoltaics by Using Alloyed (FA1- xCsx)Pb(I1- xBrx)3 Quantum Dots,” *ACS Energy Lett.*, vol. 4, no. 8, pp. 1954–1960, 2019.
[3] A. Dey *et al.*, “State of the Art and Prospects for Halide Perovskite Nanocrystals,” *ACS Nano*, vol. Article AS, 2021.
[4] J. Noguera-Gómez *et al.*, “Solution-Processed Ni-Based Nanocomposite Electrocatalysts: An Approach to Highly Efficient Electrochemical Water Splitting,” *ACS Appl. Energy Mater.*, vol. 4, no. 5, pp. 5255–5264, May 2021.

# DNA-based Hydrogels for High-performance Microarray and Potential Optical Biosensing Application

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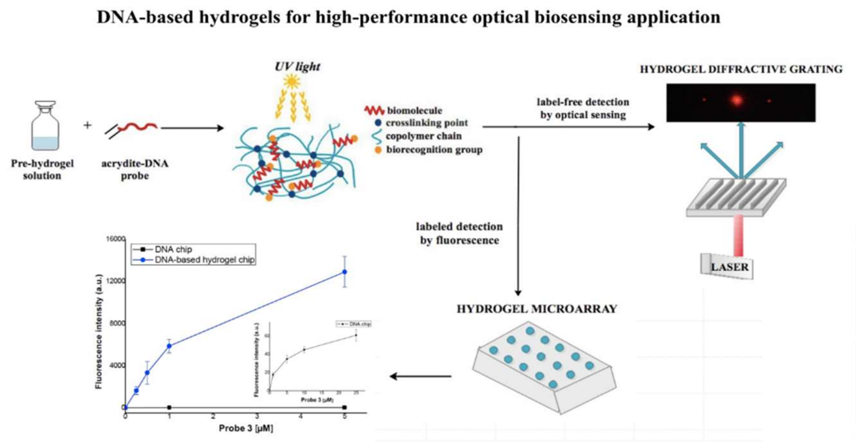
Hydrogels are three dimensional networks characterized by the ability to retain a large amount of water. This feature makes them ideal for a variety of applications, such as biosensing, drug delivery, immunotherapy and tissue engineering [1]. Furthermore, they are suitable for multiplexing, miniaturization and label-free systems. Three-dimensional (3-D) hydrogel matrixes offer significant advantages for catching probes over more conventional two dimensional (2-D) rigid substrates and, additionally, they provide a solution-mimicking environment that makes them attractive supports for bio-analysis [2]. Here, the design of DNA-based hydrogel and its application as sensing platform for the detection of a specific target sequence is presented (Scheme 1). Analyte-sensitive DNA-based hydrogel was obtained via a free radical co-polymerization process. Such hydrogels can be synthesized with desired recognition ability through the selection of a certain nucleotide sequence. In this work, a simple one-step probe immobilization procedure is reported: DNA probe molecules are added to the photoactive polymer mixture, dispensed onto a solid support, or a mould, and covalently attached while the hydrogel is formed through UV light exposure. Acrydite-modified DNA were used to directly co-polymerize with acrylamide monomers during gel formation. In this method, the UV light plays a double role as it catalyzes both the polymerization of acrylamide monomers and the covalent attachment with DNA probes. Basically, a simple one-step immobilization process for hydrogel 3D-microarray fabrication was shown and, additionally, its transfer in label-free biosensing was explored. Firstly, it was demonstrated the application of DNA-based hydrogel to detect the target with high performance in fluorescence microarray format. The DNA-hydrogel microarrays fabricated, thereby, allowed high and reproducible yields, increased stability of the attachment and low non-specific binding. On the other hand, for future applications as label-free system, a diffraction grating has been produced on the hydrogel surface by replica moulding (REM) and employed as optical transducer. Accordingly, our future objective will be the combination of this high-performance biosensor with transductors that allow working in label-free format. Hence, the developed strategy could be applied to the fabrication of point-of-care devices for biomolecular detection in medical diagnostics.



**Scheme1.** Strategy employed for the design of DNA-based hydrogel and biorecognition results in microarray format and, additionally, diffractive grating fabrication for future label-free format.

**References**

(1) Ullah, F.; Othman, M. B. H.; Javed, F.; Ahmad, Z.; Akil, H. M., *Mater. Sci. Eng. C* **2015**, *57*, 414–433.

(2) Rubina, A. Y.; Dementieva, E. I.; Stomakhin, A. A.; Darii, E. L.; Pan'kov, S. V.; Barsky, V. E.; Ivanov, S. M.; Konovalova, E. V.; Mirzabekov, A. D., *Biotechniques* **2003**, *34* (5), 1008–1022.

# Spin crossover modulation via guest interaction in 2D Hofmann-type coordination polymers

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This work details the synthesis and characterization of a new family of Spin Crossover[1] (SCO) 2D Hofmann-type coordination polymers (2D-HCP) formulated $\{Fe(5\text{-}NH_2Pym)_2[M^{II}(CN)_4]\}\cdot G$ (5-$NH_2Pym$ = 5-aminopyrimidine; $M^{II}$ = Pt ($\mathbf{1^{Pt}\cdot G}$), Pd ($\mathbf{1^{Pd}\cdot G}$); G = none, $H_2O$, MeOH and EtOH). Both derivatives were obtained as $\mathbf{1^{M}\cdot H_2O}$ via liquid-liquid diffusion methods as single crystals. They exhibit a two-step spin transition stemming from the presence of two crystallographically distinct $Fe^{II}$ ions generated by host-guest interactions. Upon heating both compounds up to 400K, a single-crystal to single-crystal loss of the guest water molecule is induced, driving to the corresponding $\mathbf{1^{Pt}}$ and $\mathbf{1^{Pd}}$ dehydrated counterparts. These desorbed compounds display complete single-stepped SCO curves explained by the existence of a unique type of $Fe^{II}$ center in the bimetallic framework. Furthermore, the activated $\mathbf{1^{Pt}}$ and $\mathbf{1^{Pd}}$ compounds are able to re-adsorb either molecules of water, even in atmospheric conditions, recovering the original two-stepped SCO behavior or methanol/ethanol which partially block the HS → LS transition of the resulting $\mathbf{1^{M}\cdot MeOH}$ and $\mathbf{1^{M}\cdot EtOH}$ frameworks. Time dependent solvent adsorption/desorption isotherms have been performed to study their host-guest chemistry, primarily assisted by the tendency of the amino group to form hydrogen bonds, making the reported 2D-HCP systems a powerful platform for the development of future sensor devices.

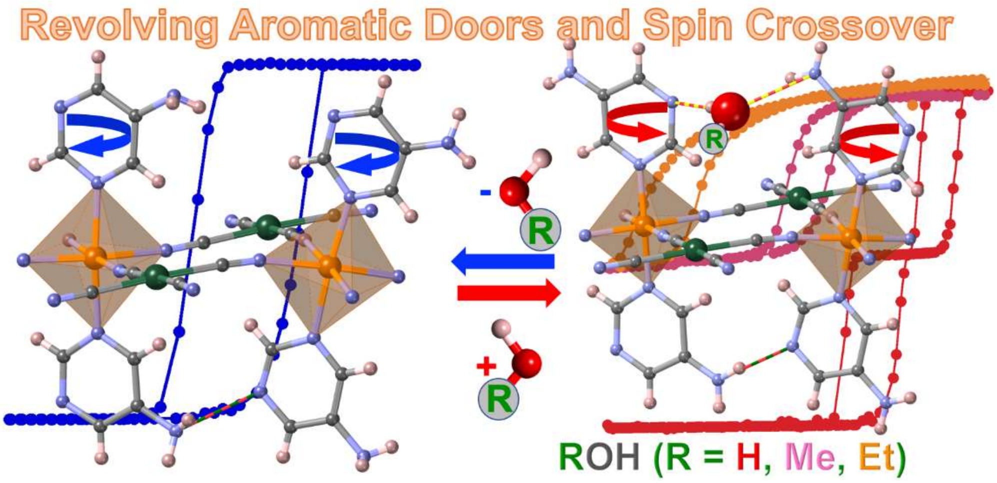

**Figure 1.** Magnetic properties of the $\mathbf{1^{Pt}\cdot ROH}$ (R = H, Me, Et) derivatives with a superimposed fragment of the ROH supramolecular interaction with the host framework. Blue and red arrows indicate the 180º flip of the ligand upon guest adsorption.

## References

[1] a) Gütlich, P.; Goodwin, H. A. (Eds) *Top. Curr. Chem.* **2004**, *233*, Springer; b) Muñoz, M. C.; Real, J. A. *Coord. Chem. Rev.* **2011**, *255*, 2068-2093.

[2] Turo-Cortés, R.; Bartual-Murgui, C.; Castells-Gil, J.; Muñoz, M. C.; Martí-Gastaldo, C.; Real, J. A. *Chem. Sci.* **2020**, *11*, 11224-11234.

## Poster contributions

**P1. Cristian Martínez Hernández.** Anilato-based heterometallic networks showing ferrimagnetic ordering and proton transfer.

**P2. Francisco José Sierra Molero.** Photo-Catalyzed Aerobic Oxidative Functionalization of 3,4-Dihydroquinoxalin-2-ones with Pyrazolones as Nucleophiles.

**P3. Jordi Torró.** Catalytic enantioselective addition of isoxazol-5-ones to aurone-derived 1-azadienes.

**P4. Joan Vicent Estornell Martínez.** Oxidative functionalization of 1,2,4,5-tetrahydro-1,4-benzodiazepine-3-ones.

**P5. Cristina Pintado Zaldo.** The impact of ethylene glycol versatility on magnetic properties and structure in anilato-based Single Ion Magnets.

**P6. Víctor García García.** Organophotoredox 1,6-addition of dihydroquinoxalin-2-ones to p-quinone methides using visible-light.

**P7. Pablo García Aznar.** Computational investigations on the reactivity of inverse electron-demand Diels-Alder reactions of fused-norbornenes with 3,6-dipyridin-2-yl-1,2,4,5-tetrazine.

**P8. Laura Carceller Ferrer.** Organocatalytic enantio- and diastereoselective cyclopropanation of alkylidenepyrazolones with bromomalonates.

**P9. Marcos Escolano.** Novel organocatalytic protocol to access chiral fluorinated indolizidines.

**P10. Aitor Cubells Gómez.** Holographic Surface Diffraction Gratings Made of Protein Hydrogels for Label-Free Biosensing.

**P11. Murta Capella-Argente.** From ladder to dimer, the size matters and from paramagnetic to single-ion magnets, lanthanoids make the difference.

**P12. Lidia Prieto.** Development of new anticancer agents: synthesis of combretastatin A4 analogues.

**P13. Birgit Felderer.** Quantification of THP-1 cells in medium measured in FT-IR Transflection.

**P14. Kevin U. Antela.** Development of a colorimetric device by using Arduino.

**P15. Patricia García.** Assessment of the inhalation uptake of MDMB-4en-PINACA using a smoking simulation chamber.

**P16. Jaume Béjar Grimalt.** Diagnosis of Prostate Cancer using IR spectroscopy and Machine Learning.

**P17. Francisco López Moreno.** Organocatalytic Enantioselective Double Michael Addition of Isoxazol-5-ones to Symmetric Dibenzalacetones.

**P18. Jeanne Charollais.** Theoretical study of the optical properties of a peroxynitrite generator activatable with red light.

**P19. Belén Monforte Gómez.** Improvement of Griess reaction for nitrite and nitrate determination in water samples with PDMS membranes and ZnNPs as reductor.

**P20. Jose Luis Moreno Casillas.** Miniaturized liquid chromatography of paracetamol.

**P21. Alberto Llopis Lacruz.** Chiral Functionalization of Polymer-Based Nanoparticles for Catalysis and Photocatalysis.

**P22. Christian Rodríguez Boscà.** Polymer Coatings with Nanoencapsulation of Organic Phase Change Materials for Thermal Energy Storage.

**P23. Miguel Muñoz Bartual.** Laser pointer activation for polimerization of paper-based devices.

# Anilato-based heterometallic networks showing ferrimagnetic ordering and proton transfer

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The synthesis and characterization of new molecule-based magnets is an important field in molecular magnetism. One of the main challenges in this area is the possibility of tuning the ordering temperatures ($T_C$) by modifying the corresponding building blocks. In this work, we have synthesized and characterized a total of ten new anilato-based heterometallic networks with formula $[(H_3O)(phz)_3][M^{II}M^{III}(C_6O_4X_2)_3]\cdot G$ ($M^{II}/M^{III}/X$ = Fe/Cr/Cl (**1**), Fe/Cr/Br (**2**), Cu/Cr/Cl (**3**), Cu/Cr/Br (**4**), Co/Fe/Cl (**5**), Co/Fe/Br (**6**), Cu/Fe/Cl (**7**), Cu/Fe/Br (**8**), Fe/V/Cl (**9**) and Fe/V/Br (**10**). These compounds are made up of cationic and anionic layers whose eclipsed packaging originates hexagonal channels (Fig. 1, left). Subunits of the cationic layer establish strong hydrogen bonds with a proton transfer that depends on the size of the metallic cations (Fig. 1, right). The combination of the metal ions also offers a way of tuning the intensity of the magnetic coupling and therefore the value of the ordering temperature (Fig 2).[1]

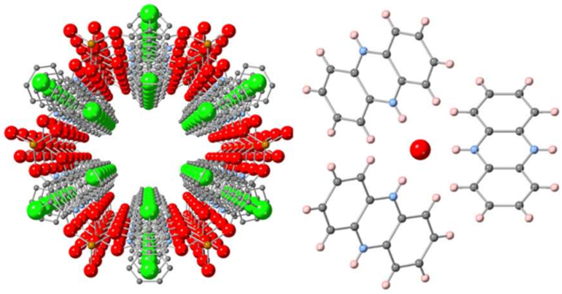

**Figure 1.** View of a hexagonal layer (left) and view of the subunits of the cationic layer (right) in compounds $[(H_3O)(phz)_3][M^{II}M^{III}(C_6O_4X_2)_3]\cdot G$

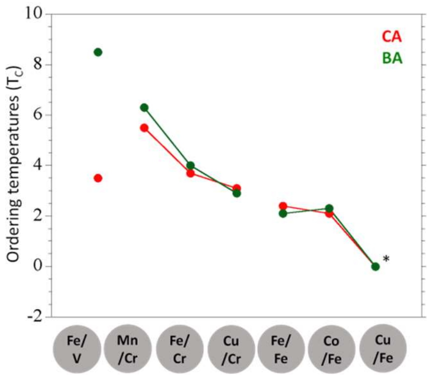

**Figure 2.** Ordering temperature dependence with the metal ion combination.

**References**

[1] Atzori, M.; Benmansour, S.; Minguez Espallargas, G.; Clemente-Leon, M.; Abherve, A.; Gomez-Claramunt, P.; Coronado, E.; Artizzu, F.; Sessini, E.; Deplano, P.; Serpe, A.; Mercuri, M. L.; Gomez Garcia, C. J. *Inorg. Chem.* **2013**, *52*, 10031-10040.

# Photo-Catalyzed Aerobic Oxidative Functionalization of 3,4-Dihydroquinoxalin-2-ones with Pyrazolones as Nucleophiles

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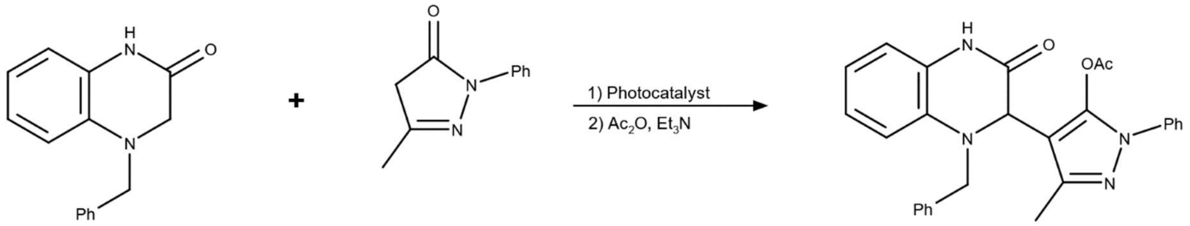
Carbon-carbon bond forming reactions constitute an indispensable tool in the organic chemists' toolbox, and as such, plenty of effort is put into the search and development of such reactions. Regarding this, C-C oxidative coupling via visible light photoredox catalysis has emerged recently as a promising alternative. [1] Visible light photocatalysis not only presents a wide variety of advantages, including mild conditions and ease of operation, but also represents a great opportunity in the development of a more sustainable chemistry (green chemistry), since visible light (sunlight) is a non-expensive energy source, renewable and easily accessible.

On the one hand, 3,4-dihydroquinoxalin-2-ones are often found in pharmaceutical products due to their great number of biological activities, specially those that are C3-substituted. [2] While pyrazolones also present biological activities, and its derivatives are in fact one of the oldest synthetic pharmaceuticals, being first prepared in 1883. [3] Thus, bringing together these two types of molecules could open up new possibilities in the drug development.

On that account, here we describe the visible light photocatalyzed reaction between 3,4-dihydroquinoxalin-2-ones and pyrazolones, where a C-C oxidative coupling occurs to give the 3,4-dihydroqunoxalin-2-one [4] functionalized in its C3 position with a pyrazolone moiety, using atmospheric oxygen as terminal oxidant and 9,10-dihydrophenanthrene-9,10-dione as photocatalyst, which are environmentally friendly reaction conditions.



**Scheme 1.** Photo-functionalization of 3,4-dihydroquinoxalin-2-ones with pyrazolones

**References**

[1] *Visible Light Photocatalysis in Organic Chemistry*, Stephenson, C. R. J.; Yoon, T. P.; MacMillan, D. W. C. Wiley-VCH, Weinheim, 2018.

[2] Rostoll-Berenguer, J.; Blay, G.; Pedro, J. R.; Vila, C. *European J. Org. Chem.* **2020**, 6148–6172.

[3] Brogden, R. N. *Drugs* **1986***, 32*, 60–70.

[4] Rostoll-Berenguer, J.; Blay, G.; Pedro, J. R.; Vila, C. *Synthesis* **2020***, 52*, 544–552.

# Catalytic enantioselective addition of isoxazol-5-ones to aurone-derived 1-azadienes.

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Organocatalysis is an efficient methodology to synthetize enantiomerically enriched compounds from non chiral starting materials. This area has received great interest from organic chemists in recent years.

The aurone-derived 1-azadienes are versatile building blocks owing to the driving force of aromatization and have been widely utilized as suitable Michael acceptors in conjugate addition reactions to easily access enantiomerically enriched benzofuran derivatives.[1]

On the other hand, the isoxazol-5-one framework can be found in many natural products and its study is interesting for the synthesis of drugs and new materials. They have a strongly acidic C4-H (comparable to carboxílic acids), three potential nucleophilic sites and a weak N-O bond that allows the descarboxilation which can serve as the entropic driving force for a number of transformations.[2] So the study of reactions that involve this kind of heterocycles are of great interest to organic chemists.

In this communication, we will report our results on the enantioselective addition of isoxazol-5-ones to aurone derived 1-azadienes catalyzed by a bifunctional chiral squaramide.

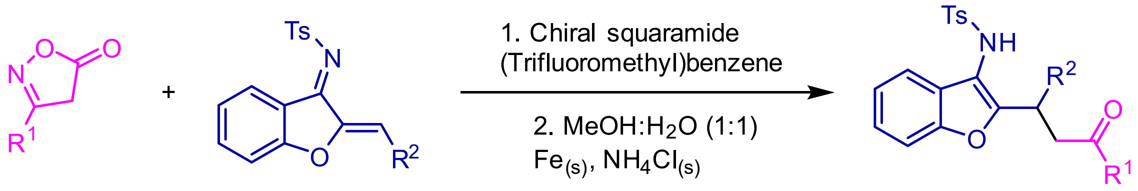

**Figure 1.** Catalytic enantioselective addition of isoxazol-5-ones to aurone-derived 1-azadienes.

**References**

[1] Koay, W.L.; Mei, G.J.; Lu, Y. Facile access to benzofuran-fused tetrahydropyridines via catalytic asymmetric [4+2] cycloaddition of aurone-derived 1-azadienes with 3-vinylindoles. *Org. Chem. Front.* **2021**, 8, 968.

[2] Jurberg, I.; da Silva, A.; Fernandes, A.; Thurow, S.; Stivanin, M. Isoxazol-5-ones as strategic building blocks in organic synthesis. *Synthesis* **2018**, *50*, 2473-2489.

# Oxidative functionalization of 1,2,4,5-tetrahydro-1,4-benzodiazepine-3-ones

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Benzodiazepines are an important family of molecules that have psychoactive properties[1] and that are well known for their use as drugs. Specifically, they have been used for years as sedatives, myorelaxing agents, anticonvulsants and anxiolytics[2]. Currently there are 35 different pharmacologically active benzodiazepines used internationally[3] among which there are well known drugs such as diazepam (Valium®), alprazolam (Xanax®), lorazepam (Ativan®), triazolam (Halcion®) and clonazepam (Klonopin®). Although 1,4-benzodiazepine-2-ones have been widely studied, their analogues 1,2,4,5-tetrahydro-1,4-benzodiazepine-3-ones have been less investigated. However, they have recently attracted considerable attention because of the publication of recent studies in which it has been shown that these nitrogen heterocycles have diverse physiological activities such as the inhibition of the vitamin D receptor in Paget's disease of bone[4] or the modulation of protein kinase C for anticancer drugs[5]. Therefore, these compounds are likely to be used in order to treat different important diseases in the future.

For this reason, a deepening in the study of the chemistry of 1,2,4,5-tetrahydro-1,4-benzodiazepine-3-ones is now an important matter in organic synthesis research considering that the development of reliable methods for the functionalization of these class of compounds could allow the design of important drugs in the future. Our functionalization strategy is focused on the oxidation of 1,2,4,5-tetrahydro-1,4-benzodiazepine-3-ones relying in the stability of the intermediate imine product which can be carried out with mild oxidizing agents such as dialkyl azodicarboxylates. The imine product can react *in situ* with nucleophiles giving different functionalized 1,4-benzodiazepine-3-ones.

**Figure 1.** Functionalization of 1,2,4,5-tetrahydro-1,4-benzodiazepine-3-ones through an imine intermediate and subsequent nucleophilic addition.

(1) Möhler, H.; Okada, T. *Science*. **1977**, *198*, 849.
(2) Jin, Q.; Zhang, D.; Zhang, J. *Org. Biomol. Chem*. **2019**, *17*, 9708.
(3) European Monitoring Centre for Drugs and Drug Addiction. Benzodiazepines drug profile. https://www.emcdda.europa.eu/publications/drug-profiles/benzodiazepines_en (accessed April 04, 2022)
(4) Mita, Y.; Dodo, K.; Noguchi-Yachide, T.; Hashimoto, Y.; Ishikawa, M. *Bioorg. Med. Chem*., **2013**, *21*, 993.
(5) Ma, D.; Wang, G.; Wang, S.; Kozikowski, A.; Lewin, N. E.; Blumberg, P. M.; *Bioorg. Med. Chem. Lett.*, **1999**, *9*, 1371.

# The impact of ethylene glycol versatility on magnetic properties and structure in anilato-based Single Ion Magnets

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The interest for two and three-dimensional materials with slow relaxation of the magnetization (Single-Ion Magnets, SIM and Single-Molecule Magnets, SMM) is a very active field.[1-5]

Herein, we present two anilato-based coordination polymers obtained by combining Dy(III) and ethylene glycol (eg) with two different anilato-type ligands (dianions of the 3,6-disubstituted-2,5-dihydroxy-1,4-benzoquinone: $(C_6O_4X_2)^{2-}$, with X = Cl and Br) and formulated as: $[Dy_2(C_6O_4Cl_2)_3(\mu\text{-eg-k}O)(H_2O)_4]\cdot 2eg\cdot 7H_2O$ (**1**), and $[Dy_2(C_6O_4Br_2)_3(\text{eg-k}^2O,O')_2(\text{eg-k}O)(H_2O)]\cdot 4eg$ (**2**). Compound **1** shows a 3D (4,6)-gon diamond net topology whereas **2** presents a 2D (3,6)-gon lattice with rectangular cavities with a brick wall disposition. Both compounds show slow relaxation of the magnetization and behave as SIM. These results highlight the outstanding role of ethylene glycol, giving rise to a rich array of crystal structures and magnetic behaviours, as zero-field and field-induced SIM.

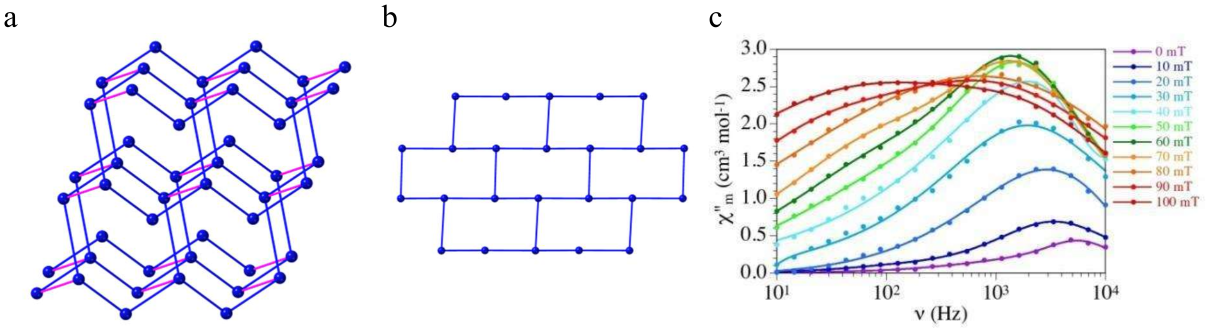

**Figure 1:** Schematic view of the 3D lattice for **1** (**a**) and 2D lattice for **2** (**b**). (**c**) Frequency dependence of the $\chi''_m$ signal at 2 K for compound **2** with different applied DC fields.

**Acknowledgments**

We thank the grant CTQ2017-87201-P funded by MCIN/AEI/10.13039/501100011033 and by "ERDF A way of making Europe" and the Generalidad Valenciana (Prometeo/2019/076) for financial support.

## References

[1] S. Benmansour, C. J. Gómez-García, A. Hernández-Paredes, *Crystals*, **2022**, *12*, 261.
[2] S. Benmansour, A. Hernández-Paredes, M. Bayona-Andrés, C. J. Gómez-García, *Molecules* **2021**, *26*, 1190.
[3] S. Benmansour, C. J. Gómez-García, *Magnetochemistry* **2020**, *6*, 71.
[4] S.Benmansour, A. Hernández-Paredes, A. Mondal, G. López Martínez, J. Canet-Ferrer, S. Konar, C. J. Gómez-García, *Chem. Commun.* **2020**, *56*, 9862-9865.
[5] A. Hernández-Paredes, C. Cerezo-Navarrete, C. J. Gómez-García, S. Benmansour, *Polyhedron* **2019**, *170*, 476-485.

# Organophotoredox 1,6-addition of dihydroquinoxalin-2-ones to *p*-quinone methides using visible-light

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The importance of moving towards less contaminant synthetic methodologies has been an important goal in recent years for the organic chemistry community. The use of visible light to promote chemical transformations has emerged as a promising tool and a proper source of energy due to its non-polluting and renewable nature.

In the context of visible-light photochemistry, organophotoredox catalysis allows us to trigger organic transformations using photocatalysts based on organic molecules, rather than those derived from heavy metals such as Ru or Ir.

Since photoredox catalysis is an effective and straightfordward way to generate α-amino radicals from tertiary amines, in this work these open-shell intermediates are generated regioselectively in 3,4-dihydroquinoxalin-2-one derivatives. This kind of compounds are interesting scaffolds that are present in many biologically active compounds as a part of their structures, such as antitumoral agents or anti-inflammatory agents.[1]

Several 1,2- and 1,4- additions[2] reactions of α-amino radicals have been described. However, the 1,6-addition is seldom studied due to their inherent regioselective issues. In this sense, *p*-quinone methides constitute a privileged scaffold to trigger 1,6-addition reactions. Herein, we present our efforts in the photoredox-catalyzed addition of 3,4-dihydroquinoxalin-2-ones to *p*-quinone methides using Fukuzimi's catalyst under the irradiation of an HP Blue LED (455 nm).

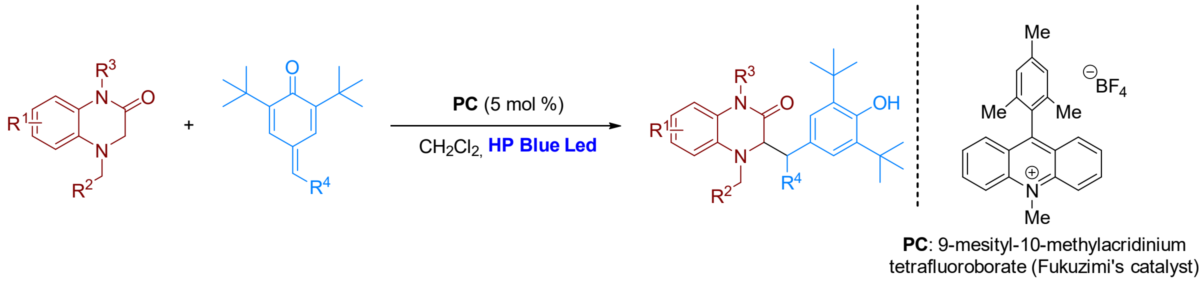

**Figure 1.** 1,6-Addition of dihidroquinoxalin-2-ones to *p*-quinone methides

**References**

[1] Tanimori, S.; Nishimura, T.; Kirihata, M. *Bioorg. Med. Chem. Lett.*, **2009**, *19*, 4119-4121.
[2] Rostoll-Berenguer, J.; Blay, G.; Pedro, J.R.; Vila, C. *Org. Lett.* **2020**, *22*, 8012−8017.

# Computational investigations on the reactivity of inverse electron-demand Diels-Alder reactions of fused-norbornenes with 3,6-dipyridin-2-yl-1,2,4,5-tetrazine

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The study of reactions rates and mechanistic insights of click chemistry reactions remains an interesting challenge in modern organic chemistry. In this regard, inverse electron demand Diels–Alder (IEDDA) reactions represent a promising metal-free alternative with enhanced reactions rates compared to other reactions of the click chemistry toolbox.[1] The emergence of the IEDDA reaction between tetrazines and strained dienophiles has allowed breakthrough advances in modern organic chemistry and has labelled the IEDDA reaction as the most optimal bioorthogonal reaction due to its extremely fast kinetics, excellent orthogonality, and biocompatibility. Among the different types of dienophiles used in IEDDA, norbornenes have been widely used given their high stability and fast reactions rates. The inverse electron-demand Diels Alder reaction of 3,6-dipyridin-2-yl-1,2,4,5-tetrazine with a series of fused-norbornene derivatives was studied with quantum mechanical calculations at M06-2X/6-311+G(d,p) level of theory. The predictions were experimentally verified and analyzed with the use of the distortion/interaction model developed by Bickelhaupt and Houk.[2] Understanding the factors that affect the relative cycloaddition rates or norbornenes with tetrazines are crucial to selectively tuning their efficacy.

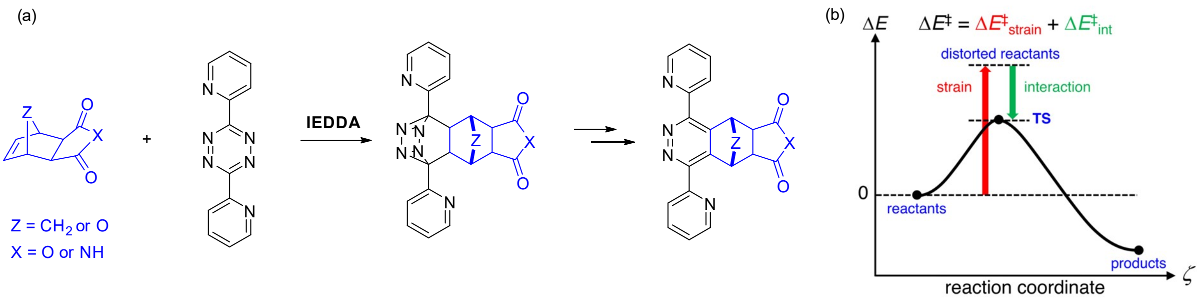

**Figure 1.** (a) Schematic representation of mechanism of the IEDDA reaction. (b) The activation strain model.

## Acknowledgments

The computational resources from the SIUV are gratefully acknowledged.

## References

[1] Deb, T.; Tu, J.; Franzini, R. M. *Chem. Rev.* **2021**, *121*, 6850−6914.
[2] Bickelhaupt, F. M.; Houk, K. N. *Angew. Chem. Int. Ed.* **2017**, *56*, 10070−10086.

# Organocatalytic enantio- and diastereoselective cyclopropanation of alkylidenepyrazolones with bromomalonates

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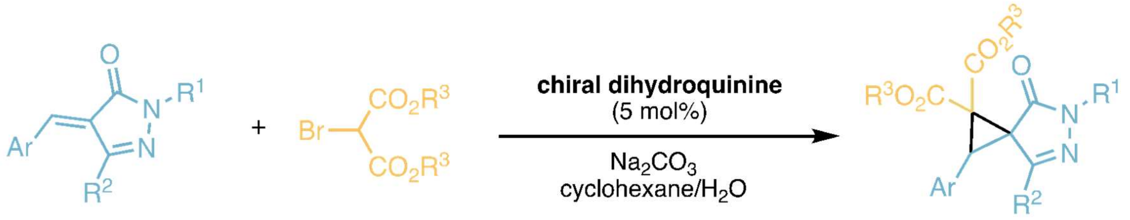
Over the last forty years, asymmetric catalysis has been a key for the building of enantiomeric enriched compounds with organocatalysts being one of the most widely used because of its facility of use and low toxicity.
In chemistry, it is well-known the importance of nitrogen heterocycles as they have a wide range of applications in pharmaceutical or other areas such as agrochemistry or medicine.[1] In this context, pyrazolone motif is a notable class of nitrogen heterocycle with an important biological activities.[2]

On the other hand, cyclopropanes are present in a wide number of natural products with different activities (insecticide, antifungal, antimitotic and even anticancer, for example). Its triangular structure provides the cyclopropane molecule unique properties derived from its inherent tension. Because of this, synthetic methodologies for its stereoselective preparation have been extensively studied.[3]

Herein, the enantio- and diastereoselective cyclopropanation of alkylidenepyrazolones with bromomalonates catalyzed by a chiral dihydroquinine-derived organocatalyst is described using mild reaction conditions (Figure 1).



>20 examples
up to 67% yield
93% *ee*
100:0 dr

**Figure 1.** Asymmetric cyclopropanation of alkylidenepyrazolones catalyzed by a chiral dihydroquinine.

The present methodology allows variation of the nucleophile and electrophile by changing the substitution with both electron-withdrawing and electron-donating groups obtaining good yield and excellent enantio- and diasstereoselectivity (up to 67% yield, 93% ee and 100:0 dr).

## References

[1] Royer, J. *Asymmetric Synthesis of Nitrogen Heterocycles*. Wiley-VCH, Weinheim, **2009**.
[2] Varvounis G., *Pyrazol-3-ones. Part IV: Synthesis and Applications*, in *Advances in Heterocyclic Chemistry*, Ed.: A. R. Katritzky, Academic Press, New York, **2009**, *98*, 143- 224.
[3] (a) Chen. D. Y.-K., Pouwer, R.H., Richard, J.-A., *Chem. Soc. Rev.*, **2012**, *41*, 4631–4642. (b) Sansinenea, E., Ortiz, A. *Eur. J. Org. Chem.* **2022**, e202200210.

# Novel organocatalytic protocol to access chiral fluorinated indolizidines

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The indolizidine scaffold is a widespread motif in a wide variety of alkaloids and natural products. Therefore, the development of synthetic methodologies that gain access to those skeletons, especially in an asymmetric manner, is highly desirable. Despite the big number of these types of derivatives described to date, examples of indolizidines bearing fluorinated substituents are almost unknown.[1]

In the present work we have performed the synthesis of the skeleton of fluorinated indolizidines in enantiomerically enriched fashion. To this end, we took advantage of the sequence intramolecular aza-Michael addition/methylenation/ring closing methatesis of conjugated amides containing an enone functionality in a remote position. This sequence, that was performed in a stepwise manner, starts with the enantioselective intramolecular cyclization of the amidic nitrogen in the presence of a chiral BINOL phosphoric acid[2], (*R*)-TRIP-PA, that give rise to the corresponding pyrrolidine derivatives in excellent ees. The second intramolecular cyclization was performed using dimethyl titanocene and the Hoveyda Grubbs second generation catalyst, affording the fluorinated indolizidines.

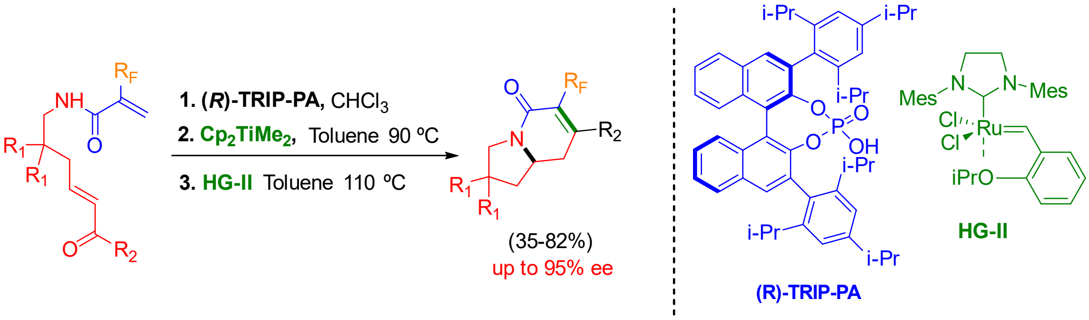

**Figure 1. Strategy to obtain chiral fluorinated indolizidines.**

**Acknowledgments**
We gratefully thank the Spanish Ministerio de Ciencia e Innovación (PID2020-115294GB-I00 to C. P) for financial support. M. E. and D. G. thank the Spanish Ministerio de Educación, Cultura y Deporte for predoctoral fellowships (FPU16/04533 and FPU18/02750).

**References**

[1] a) Marhold, M.; Stillig, C.; Fröhlich, R.; Haufe, G. *Eur. J. Org. Chem.* **2014**, 5777–5785. b) F. M. Cordero, F. M.; Vurchio, C.; Faggi, C.; Brandi, A. *Org. Chem. Front.* **2016**, *3*, 1651–1660.

[2] Escolano, M.; Torres-Fernández, J.; Rabasa-Alcañiz, F; Sánchez-Roselló, M.; del Pozo, C.; *Org. Lett.* **2020**, *22*, 9433-9438.

# Holographic surface diffraction gratings made of protein hydrogels for label-free biosensing

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The development of new selective sensors for certain biomarkers is important in order to detect the presence of the disease early, reducing its impact and adverse effects.[1] To this end, work is being done on the development of label-free (LF) optical biosensing using holographic techniques. The proposed approach is based on the use of biosensitive hydrogels with a holographic 2D diffraction network as a transducer for biorecognition. Typically, hydrogel gratings can transduce the presence of an analyte into a diffraction signal change due to an analyte-induced structural modification of the polymer.[2]

This communication demonstrates the anti-BSA specific label-free biosensing by a bovine serum albumin (BSA) biofunctionalized hydrogel diffraction grating. First, hydrogels were characterized by swelling, SEM, porosity, and biorecognition of the anti-BSA antibody was assessed by fluorescence. Finally, surface relief gratings were fabricated on the optimized hydrogels by replica molding using holographic masters. The optical LF specific detection of anti-BSA antibodies by the fabricated gratings was demostrated measuring the changes in the diffraction efficiencies.

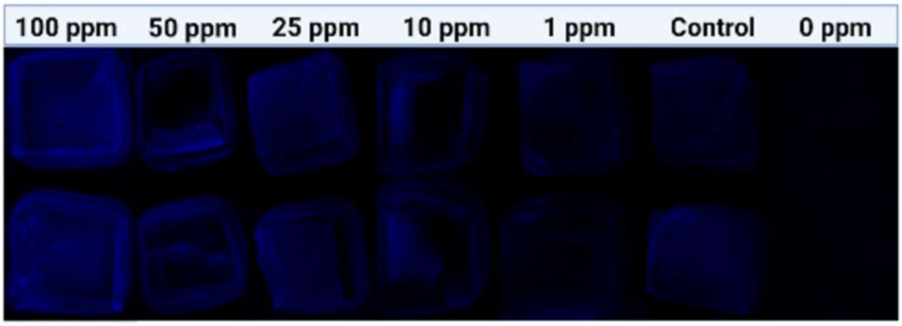

**Figure 1.** Image of hydrogels incubated with increasing concentrations of labelled anti-BSA-Alexa647 and anti-Rabbit-Alexa647 for 4h after washing over night with PBS-T.

**Acknowledgments**
This research was funded by MINECO (PID2019-110713RB-I00) and Generalitat Valenciana (PROMETEO/2020/094).

**References**

[1] Mascini, M.; Tombelli, S. *Biosensors for Biomarkers in Medical Diagnostics*. *Biomarkers* **2008**, 13 (7–8), 637–657
[2] Peng, H.-Y. et al. *J. Mater. Chem.* C **2018**, 6, 11356−11367.

# From ladder to dimer, the size matters and from paramagnetic to single-ion magnets, lanthanoids make the difference

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In this work we complete the first series of complexes, with lanthanoid ions and the nitranilato ligand, [1] (nitranilate = $[C_6O_4(NO_2)_2]^{2-}$ = dianion of the 3,6-dinitro-2,5-dihydroxo-1,4-dibenzoquinone). This family starts with a ladder like structure (Figure 1a), found for Ln(III) = La, which can be formulated as $[La_2(C_6O_4(NO_2)_2)_3(H_2O)_8]\cdot 3H_2O$ (**1**), whereas the rest of lanthanoids form dimers (Figure 1b), formulated as $[Ln_2(C_6O_4(NO_2)_2)_3(H_2O)_{10}]\cdot nH_2O$. Here we present the synthesis, structure and magnetic properties for Ln(III) = Ce (**2**), Pr (**3**) and Nd (**4**). Additionally, we also present the magnetic properties of the Dy (**5**) and Er (**6**) derivatives showing that the Ln(III) ions are magnetically well isolated, leading to the presence of a field-induced single-ion magnet behaviour in both compounds. This behaviour has recently been observed in other Dy(III)-anilato lattices and in only one Er(III) compound.[2-5]

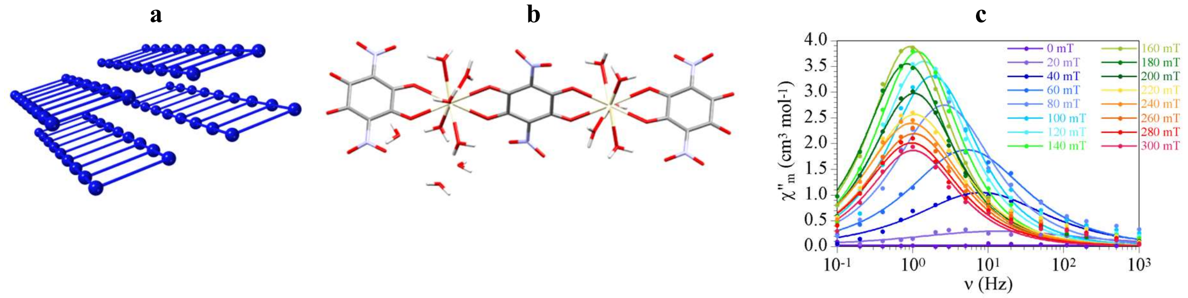

**Figure 1:** (**a**) Schematic view of the ladder lattice for **1**. (**b**) Dimeric structure for **2**-**6**. (**c**) Frequency dependence of the $\chi''_m$ signal at 2 K for compound **5** with different applied DC fields.

## Acknowledgments

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## References

[1] S. Benmansour, G. López-Martínez, J. Canet-Ferrer, C. J. Gómez-García, *Magnetochemistry,* **2016**, *2*, 32.
[2] S. Benmansour, C. J. Gómez-García, A. Hernández-Paredes, *Crystals*, **2022**, *12*, 261.
[3] S. Benmansour, A. Hernández-Paredes, M. Bayona-Andrés, C. J. Gómez-García, *Molecules* **2021**, *26*, 1190.
[4] S. Benmansour, C. J. Gómez-García, *Magnetochemistry* **2020**, *6*, 71.
[5] S.Benmansour, A. Hernández-Paredes, A. Mondal, G. López Martínez, J. Canet-Ferrer, S. Konar, C. J. Gómez-García, *Chem. Commun.* **2020**, *56*, 9862-9865.

# Development of new anticancer agents: synthesis of combretastatin A4 analogues

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Due to the rising incidence in tumor development worldwide, there is an increased interest in the development of new pharmacotherapeutic agents. One of these agents is CA-4, a microtubule destabilizing antimitotic agent, which arrests the cell cycle in the transition from meta to anaphase stages. Its disadvantages for clinical use have led to research analogues with improved properties, such as 1,5-disubstituted and 1,2,3-triazoles. In this project, different analogues of CA-4 were prepared, some of which have not been previously described in the bibliography using Huisgen 1,3-dipolar cycloaddition to synthesize these triazoles, from azides and terminal alkynes (Figure 1).

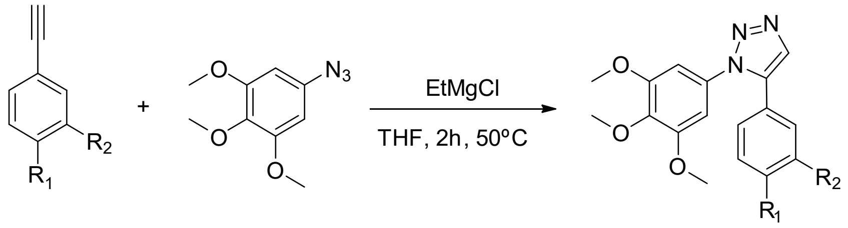

**Figure 1.** Huisgen 1,3-dipolar cycloaddition from azides and terminal alkynes.

The intention was to perform a proof of concept about a new method of drug development, known as kinetic target guided synthesis (KTGS), where the target is used (in this case tubulin) as a mould to synthesize its own ligands. To prevent us from working with isolated tubulin, cytotoxic assays were carried out in cell cultures directly, comparing cytotoxic activities results between precursors and final products. The cytotoxic assay MTT was carried out in triazoles and their precursors to study the cell viability of new cell cultures, obtaining activities in the nanomolar range for the different triazoles, with good selectivity against tumoral cells. Contrary to the different terminal alkynes, the precursor azide demonstrated activity, and therefore prevented testing the success of KTGS assays. When both precursors were added in the presence of tubulin, no cellular cytotoxic activity was observed. The azide undergoes a modification which cancels its activity. To check if tubulin is able of catalysing the reaction it is necessary to perform the assays with isolated tubulin.

## References

[1] Bosc, D.; Camberlein, V.; Gealageas, R.; Castillo-Aguilera, O.; Deprez, B.; Deprez-Poulain, R. Kinetic Target-Guided Synthesis: Reaching the Age of Maturity. J. Med. Chem. 2020, 63 (8), 3817-3833. DOI: 10.1021/acs.jmedchem.9b01183

[2] Martín-Beltrán, C.; Gil-Eldo, R.; Hernández-Ribelles, G.; Agut, R.; Marí-Mezquita, P.; Carda, M. Aryl Urea Based Scaffolds for Multitarget Drug Discovery in Anticancer Immunotherapies. Pharmaceuticals. 2021, 14 (4), 337. DOI: 10.3390/ph14040337

# Quantification of THP-1 cells in medium measured in FT-IR Transflection

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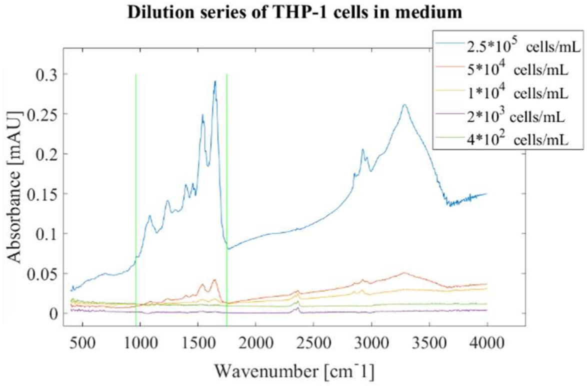
Human milk (HM) is the nutritional food source that evolved specifically to meet the needs of infants [1]. It is a highly complex matrix and much remains to be learned about its cellular content, starting by the cellular quantity. In order to develop an Infrared spectroscopy (IR) method to measure the cell concentration in HM, firstly the linear dependency between the concentration of cells in complex cell culture medium and the intensity measured by IR using transflection needs to be assessed. Therefore, a dilution series of THP-1 cells in complete cell culture medium was performed in a range of $2.5*10^5$ - $2*10^3$ cells/mL, followed by cytocentrifugation to extract the cells onto the IR slide. Figure 1 depicts a positive correlation between the absorbance and the dilution series. Further, the effect of a preconcentration of the cells due to centrifugation and solving in PBS was evaluated. For the calibration line the absorption of the peak area of the protein bands [2] [here: 1750 - 960 $cm^{-1}$] were used (figure: region comprised between the green lines). Due to the preconcentration, the measured intensity increases, thus reducing the limit of detection from 4 cells/µL to less than 4 cells/mL. However, due to the preconcentration the $R^2$ is lowered from 0.9964 (without preconcentration) to 0.9626. Proving that the intensity shows a linear dependency onto the cell concentration, the next step will be to establish a method to achieve this linearity within HM.



**Acknowledgement**

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J.K. and I.T.-D. acknowledges the grant CP16/00034 and CD19/00176 from the Instituto Carlos III. J.K. and D.P.-G. acknowledges support from the innovation aids from the VLC-Biomed program (AP2020-10).

## References

[1] Dessì, A.; Briana, D.; Corbu, S.; Gavrili, S.; Marincola, F. C.; Georgantzi, S.; Pintus, R.; Fanos, V.; Malamitsi-Puchner, A. *Metabolites*, **2018**, 8, 79-89.
[2] Sabbatini, S.; Conti, C.; Orilisi, G.; Giorgini, E. *Biomedical Spectroscopy and Imaging,* **2017***, 6, 85–99.*

# Development of a colorimetric device by using Arduino

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In the present work, a portable colorimeter has been developed with the use of Arduino. Arduino is a low-cost platform for embedded computing that changed the landscape of microcontrollers [1,2]. Microcontrollers are small computers contained on a single integrated circuit or computer chip, and are an excellent way to program and control electronic components [3]. Among sensors that are available to be programmed with Arduino are the radiant sensors and within these sensors can be found the color sensors [4].

The device presented has been developed using an Arduino UNO R3 connected to a TCS34725 color sensor (Figure 1). Given the properties of color and light, the device has been developed with two modalities: color determination by transmittance (Figure 2.A) and color determination by reflectance (Figure 2.B). The device has an LCD screen to display the RGBC (Red, Green, Blue, Clear) values provided by the sensor.

All in all, this presentation describes the initial stages of the development of a lab-made colorimeter, which can be replicated elsewhere with a very low associated cost.

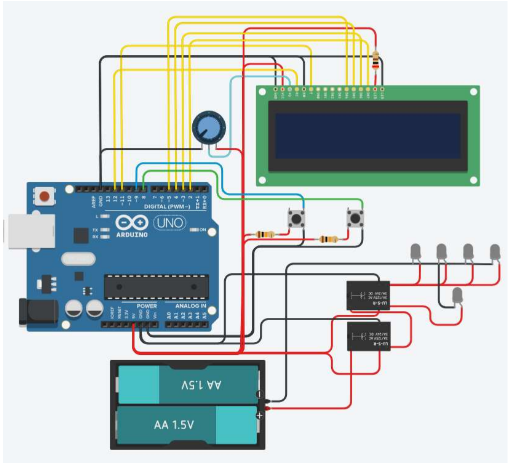

**Figure 1.** Colorimetry assemble scheme.

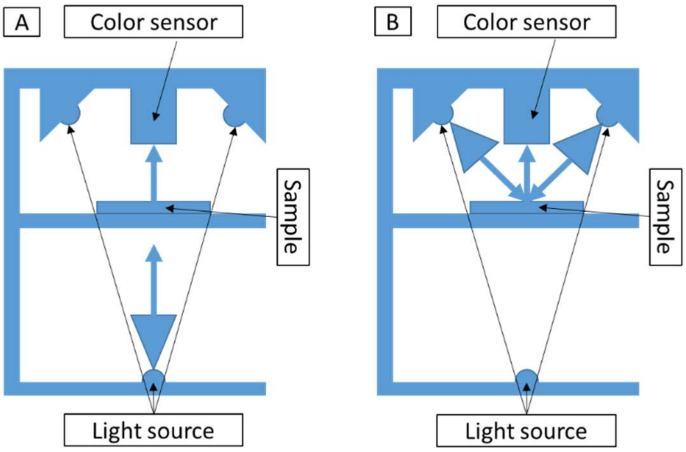

**Figure 2.** Arrangement light source-sample-detector for transmittance mode (A) and reflectance mode (B).

**Acknowledgments**
Authors knowledge the financial support of GVA-PROMETEO-2019-056.

**References**

[1] Dean Brook, J.; Bruce, R. F.; Reiser, S. L. *J. Comput. Sci. Coll.* **2009**, *25, 2, 129-130.*
[2] Perea, F. In *Arduino essentials*. Packt Publishing: UK, Birmingham, 2015.
[3] Nussey, J. In Arduino for dummies. John Wiley & Sons: Chichester, England, 2013.
[4] Color Sensor - Color Light-To-Digital Converter – TCS34725 https://ams.com/tcs34725#tab/description (accessed February 16, 2022).

# Assessment of the inhalation uptake of MDMB-4en-PINACA using a smoking simulation chamber

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In this study, a simulation chamber has been designed for the estimation of the inhalation uptake of MDMB-4en-PINACA during conventional smoking using a dedicated smoking machine. A specifically modified closed enclosure model HZ08252, with 640 L internal volume, a clean air flow of 2.0 L $\text{min}^{-1}$ and two fans with vibration-dampening rubber corners, to assure air homogeneity, was used as simulation chamber. It was placed in a 50 $m^3$ closed room, with controlled temperature (25 ± 1 °C) and humidity (48 ± 1 %). A smoking machine consisting of a Laboports mini diaphragm vacuum pump, operating at 5.5 L $\text{min}^{-1}$, was connected to the cigarette that was completely consumed after 5 min, and introduced inside the simulation chamber.

Synthetic cannabinoids are the new psychoactive substances with highest occurrence in the black market, synthetized as an alternative of natural cannabinoids with higher potency for both $CB_1$ and $CB_2$ receptor subtypes. Synthetic cannabinoids are typically sold as herbal smoking mixtures impregnated with one or several psychoactive substances, being the main route of administration through inhalation delivered by smoking a conventional or electronic cigarette.[1] Recently, several European countries issued alerts after low-tetrahydrocannabinol cannabis products were found to be adulterated with synthetic cannabinoid receptor agonists, like MDMB-4en-PINACA.[2] This synthetic cannabinoid made its first appearance on the drug market in 2018, became one of the most popular in recent years.[3]

In the smoking simulation chamber the cigarette was burned and smoke was driven by a 10.5 cm silicone tube (0.7 cm i.d.) that simulates trachea, and bubbled to a twin-trap containing 20 mL pH 7 phosphate saline buffer (simulating lung absorption) and 20 mL hexane to trap non-absorbed compounds, respectively. Cigarettes were made by using 200 mg herbal smoking mixtures containing MDMB-4en-PINACA, a rolling paper, and a smoking filter. MDMB-4en-PINACA was determined in the filter, silicone tube and phosphate saline and hexane solutions by liquid chromatography fluorescence detection (LC-FD). In summary, the developed smoking simulation chamber allows the rapid and simple estimation of the inhalation uptake of synthetic cannabinoids.

## Acknowledgments

Authors gratefully acknowledge the financial support of the project (PID2019-110788GB-I00) funded by MCIN/AEI/10.13039/501100011033.

## References

(1) Naqi, H. A.; Pudney, C. R.; Husbands, S. M.; Blagbrough, I. S. Analysis of Synthetic Cannabinoid Agonists and Their Degradation Products after Combustion in a Smoking Simulator. *Anal. Methods* **2019**, *11* (24), 3101–3107. https://doi.org/10.1039/c9ay00722a.

(2) Oomen, P. E.; Schori, D.; Tögel-Lins, K.; Acreman, D.; Chenorhokian, S.; Luf, A.; Karden, A.; Paulos, C.; Fornero, E.; Gerace, E.; Koning, R. P. J.; Galindo, L.; Smit-Rigter, L. A.; Measham, F.; Ventura, M. Cannabis Adulterated with the Synthetic Cannabinoid Receptor Agonist MDMB-4en-PINACA and the Role of European Drug Checking Services. *Int. J. Drug Policy* **2022**, *100*, 103493. https://doi.org/10.1016/j.drugpo.2021.103493.

(3) Monti, M. C.; Zeugin, J.; Koch, K.; Milenkovic, N.; Scheurer, E.; Mercer-Chalmers-Bender, K. Adulteration of Low-Delta-9-Tetrahydrocannabinol Products with Synthetic Cannabinoids: Results from Drug Checking Services. *Drug Test. Anal.* **2022**. https://doi.org/10.1002/dta.3220.

# Diagnosis of Prostate Cancer using IR spectroscopy and Machine Learning

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Prostate cancer (PCa) is the most frequent noncutaneous malignancy in the male population. The current form of testing for detecting PCa is by testing the level of prostate specific antigen (PSA) in blood, however, a high level of serum PSA is not necessarily evidence of PCa, since it can be attributed to benign prostatic hyperplasia. Because of that, it is necessary to developpe screening methods to identify potential patients more accurately. Here we propose the chemometric treatment of the infrared (IR) spectrum of raw urine to discriminate between samples from prostate cancer (N=16) and control patients (N=22). A few microliters from urine samples from patients were dried onto an Attenuated total reflectance crystal (ATR) and the mid infrared spectra was measured. Unsupervised multivariate analysis using principal component analysis (PCA) was used to find possible trends of variation in the dataset related to the presence of cancer. Figure 1 shows that the combination of PC4 and PC3 led to a partial discrimination (Figure 1, Left). Finally, supervised methods such as Partial least Squares - Discriminant analysis (PLSDA) was employed to create a discriminant model to predict the presence of cancer. Due to limitations in the number of patients, cross validation was used, showing good discrimination capability (Figure 1, Right) with a correct classification of 84,2%. Although the results obtained from this analysis look promising, they should be validated with an external dataset.

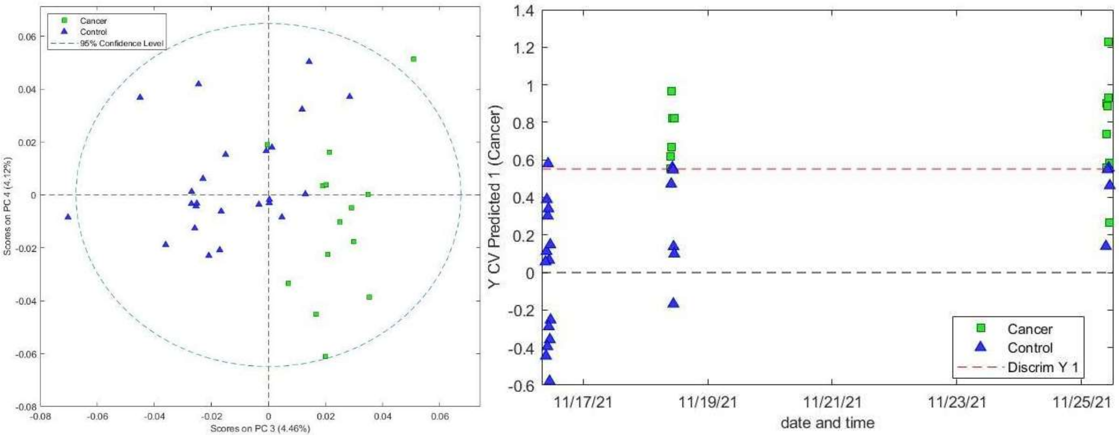

**Figure 1.** Scores for the PCA (left) and PLSDA (right) performed for the data set

## Acknowledgments

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# Organocatalytic Enantioselective Double Michael Addition of Isoxazol-5-ones to Symmetric Dibenzalacetones

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The use of isoxazol-5-ones as strategic building blocks in organic synthesis[1] has recently allowed exciting new strategies for the preparation of numerous compounds, such as pyridines, quinolines, azirines, alkynes and piperidines, among others. In this context, spiroisoxazole-5-ones can be also seen as valuable organic molecules due to their potential biological activities and unusual chemical structures.[2] Furthermore, the spirocyclic motif is becoming a prevalent template in drug discovery since this structural feature conveys both increased three-dimensionality for potential improved activity, and novelty for patenting purposes.[3]

Recently, the double Michael addition of carbon nucleophiles to dibenzalacetones has been reported as a new strategy for the synthesis of spirocyclic compounds.[4] In this communication, we will report our results on the organocatalytic enantioselective double Michael addition of isoxazol-5-ones to dibenzalacetones. The reaction provides the corresponding spiroisoxazole-5-ones[5] bearing a spiranic quaternary stereocenter with moderate yields and good enatiomeric excesses. The stereochemical implications of the reaction are also discussed.

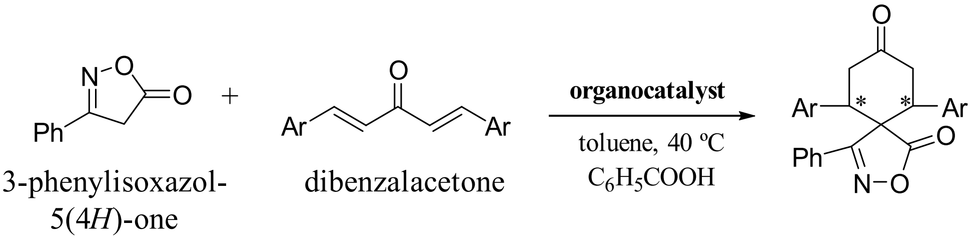

**Figure 1.** Double Michael addition of isoxazol-5-ones to dibenzalacetones

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**References**

[1] da Silva, A. F.; Fernandes, A.; Thurow, S.; Stivanin, M.; Jurberg, I. D. *Synthesis* **2018**, *50*, 2473-2489.
[2] Chande, M. S.; Verma, R. S.; Barve, P. A.; Khanwelkar, R. R.; Vaidya, R. B.; Ajaikumar, K. B. *Eur. J. Med. Chem.* **2005**, *40*, 1143-1148.
[3] Zheng, Y.; Tice, C. M.; Singh, S. B. *Bioorg. Med. Chem. Lett.* **2014**, *24*, 3673-3682.
[4] He, T.; Peng, L.; Li, S.; Hu, F.; Xie, C.; Huang, S.; Jia, S.; Qin, W.; Yan, H. *Org. Lett.* **2020**, *22*, 6966-6971.
[5] da Silva, A. F.; Leonarczyk, I. A.; Ferreira, M. A. B.; Jurberg, I. D. *Org. Chem. Front.* **2020**, *7*, 3599-3607.

# Theoretical study of the optical properties of a peroxynitrite generator activatable with red light

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The development of novel anticancer therapies has received a lot of efforts in the last years. Classical anticancer strategies based on traditional chemotherapy agents suffer from severe and systemic side effects. Therefore, there is an urgent need to develop specific therapies activated only in target tissues. Among the different possibilities, light-driven therapies are one of the most promising options due to its low invasiveness and simplicity. Photodynamic therapy (PDT) is a widely used technique in which a chromophore, after light absorption and population of the triplet states, delivers biological damage through the photosensitization of $^3O_2$, yielding the highly reactive singlet dioxygen ($^1O_2$). However, certain types of tumors offer resistance to these therapies, one of the reasons being the cell efflux pumps which extrude the photosensitizers out of the cells. One possibility to solve this problem is the *in-situ* generation of peroxynitrite ($ONOO^-$), a species that combines cytotoxicity with the ability to nitrate the tyrosine amino acids of the pumps responsible of the multidrug resistance, thus decreasing this resistance.

In 2021, Sortino and coworkers [1] developed BPT-NO (Figure 1), a molecule able to generate $ONOO^-$ upon activation with red light. The authors propose a NO photorelease in the triplet state mediated by a charge-transfer state from the benzene derivative (blue) to the benzophenothiazine unit (red), coupled with the electron transfer from this latter fragment to $O_2$. The recombination of the products $O_2^{\cdot -}$ + $^{\cdot}NO$ yields $ONOO^-$. Nevertheless, a detailed description of this mechanism from an electronic structure standpoint is still missing. In this contribution we propose a thorough time-dependent density functional theory (TD-DFT) study of the optical properties of BPT-NO, including the characterization of the singlet and triplet excited states at the Franck-Condon region and in the $S_1$ and $T_1$ minima. The electron density rearrangements have been studied by computing the natural transition orbitals (NTOs), locating the $\pi,\pi^*$ states delocalized over the aromatic moieties and the charge-transfer states that could mediate the $^{\cdot}NO$ photorelease.

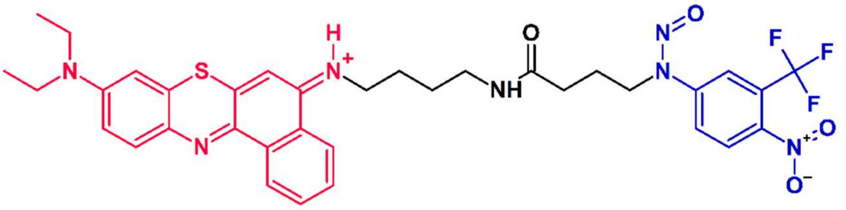

**Figure 1.** Chemical structure of BPT-NO [1]

## References

[1] Parisi, C.; *et al*, *Chem. Sci.* **2021**, *12,* 4740-4746.

# Improvement of Griess reaction for nitrite and nitrate determination in water samples with PDMS membranes and ZnNPs as reductor.

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In this study, a multi-test in 96 multi-well plates was proposed to determinate nitrites and nitrates in bottled, tap and natural waters. For that purpose, Griess reagents were embedded in a polymeric polydimethylsiloxane matrix (PDMS) doped with silica nanoparticles ($SiO_2NPs$) and an ionic liquid ($OMIMPF_6$), to determinate nitrites. The measurement of nitrates was carried out using the same methodology but applying a reducing agent composed of a dispersion of zinc nanoparticles (ZnNPs) that was immobilized in nylon. Experimental conditions of this test were optimized, and the measurement was carried out by a miniaturized spectrophotometer coupled to a mobile phone with Go Spectro App and from colored pictures from where RGB components were isolated. The results were successfully and help to enforce the characteristics to the test, improving its sustainability with a minimum consumption of reagents and the possibility of being carried out in-situ.

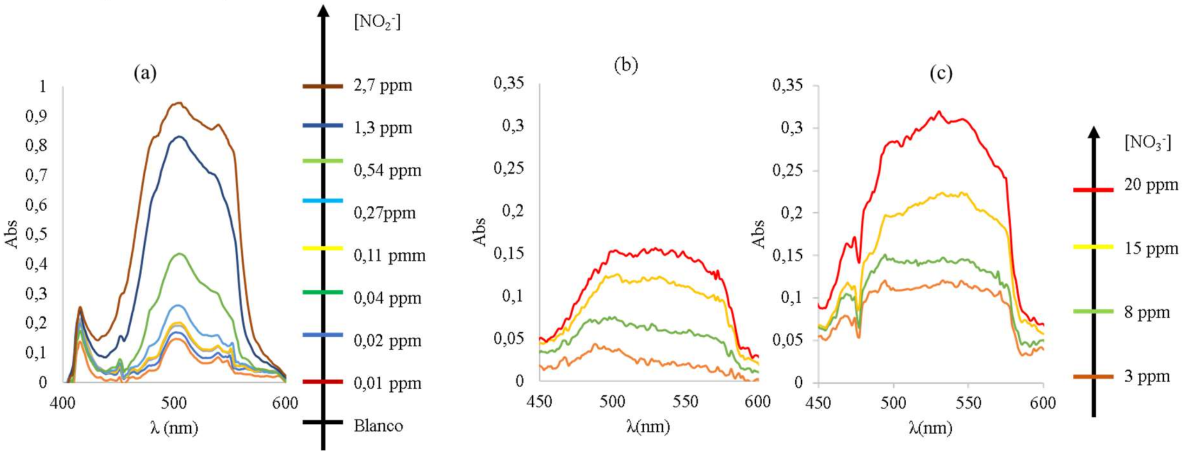

**Figure 1:** Spectra nitrite (a), nitrate with ZnNPs dispersion (b) and nitrate with ZnNPs immobilized in nylon (c) measured in a white box with LED light using a portable optical fiber coupled to a Samsung A70 smartphone and Go Spectro App.

## References

[1] Campíns-Falcó, P.; Moliner-Martínez,Y.; Herráez-Hernández, R.; Molins-Legua, C.; Verdú-Andrés, J. and Jornet-Martínez, N. Passive sensor for in-situ detection of amines in atmospheres. P201300436, 2013.

[2] Pla-Tolós, J.; Moliner-Martínez, Y.; Molins-Legua, C.; Campíns-Falcó, P. Solid Glucose Biosensor Integrated in a Multi-Well Microplate Coupled to a Camera-Based Detector: Application to the Multiple Analysis of Human Serum Samples. *Sens. Actuators B Chem.* **2018**, *258*, 331–341.

[3] Martínez-Aviño, A.; Molins-Legua, C.; Pilar, C.-F. Scaling the Analytical Information given by Several Types of Colorimetric and Spectroscopic Instruments Including Smartphones: Rules for Their Use and Establishing Figures of Merit of Solid Chemosensors. *Anal. Chem.* **2021**, *93* (15), 6043–6052

# Miniaturized liquid chromatography of paracetamol

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Nowadays, paracetamol is one of the most widely used drugs for analgesic and antipyretic purposes, so its quantification is essential[1]. Therefore, it is necessary to optimize current analytical methods in order to use less solvent volume and to use microflows in the chromatographic separation.

First, the optimal eluent composition for SPE was studied, by performing six different essays, trying different volumes, number of elution and solvents such as MeOH, ACN and $H_2O$. A single elution with 0.5 mL of MeOH:$H_2O$ (50:50), was concluded.

Applied to urine samples, different assays were carried out with a portable spectrophotometer: urine dilution, washing and recovery study. Some results are shown below:

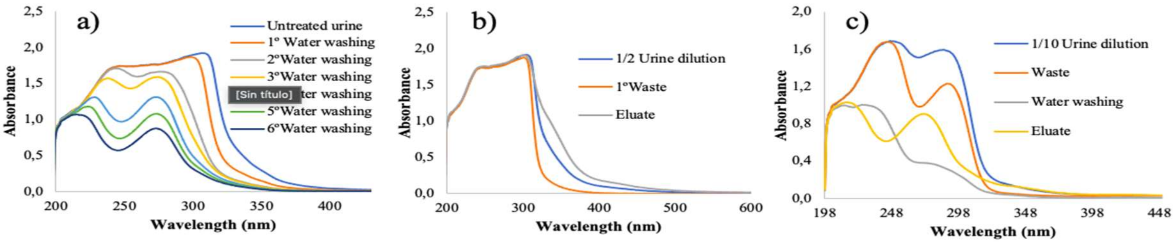

**Figure 1.** Eluate absorbance: a) sample washing study, b) 1/2 and c) 1/10 sample dilution.

The previous experiments determine the need to implement a 1/10 dilution (only 0.2 mL of sample) and a single washing step with 3 mL of nanopure water.

Finally, it has been developed a capillary liquid chromatographic method with diode array detection or mass spectrometry, which was tested for pharmaceuticals and urine. Several washing solvents and formic acid for protein precipitation of urine samples, were studied.

## References

[1] Lee, J.; Park, J.; Go, A.; Moon, H.; Kim, S.; Jung, S.; Chung, H. Urine multi-drug screening with GC-MS or LC-MS-MS using SALLE-hybrid PPT/SPE. *J. Anal. Toxicol.***2018**. *42*(9), 617–624.

# Chiral Functionalization of Polymer-Based Nanoparticles for Catalysis and Photocatalysis

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Miniemulsion polymerization is a very versatile colloidal technique that allows the synthesis of polymeric, inorganic or hybrid polymer/inorganic nanomaterials with different surface functionalities. In the case of polymeric particles, miniemulsion polymerization allows us to obtain high molecular weight polymers with low viscosity and large surface area due to the submicron size of the particles, as well as a low presence of impurities during their preparation. In addition, one of the main advantages of miniemulsion over other colloidal techniques is that it allows obtaining solid supports with uniform shape, size, size distribution and composition.[1] In this context, this work focuses on the synthesis of polymeric polystyrene nanoparticles functionalized at their surface with catalytic ligands of two types:

On the one hand, catalytic nanoparticles have been synthesized made up of a polystyrene support and functionalized with metal complexes of the Schiff base type, which have been synthesized in our laboratory.[2] Schiff bases are considered "privileged ligands" because they have the ability to form coordination complexes with practically all transition metals, giving rise to metal-Schiff-type complexes, and also some have a chiral structure that allows them to act as catalysts in a large number of asymmetric reactions.[3] Here, the catalytic activity of nanoparticles synthesized from the epoxidation reaction of three substrates: styrene, indene, and naphthalene is studied.

On the other hand, the polystyrene nanoparticles synthesized by miniemulsion polymerization can be functionalized on its surface with many different functional groups,[4] which can later react with catalysts such as Rhodamine B, an organic dye which can be an excellent catalyst for photoredox chemistry, offering low price and low toxicity. These functionalized particles demonstrated the utility of the dye through visible-light-mediated reductive dehalogenation while being covalently bonded to the nanoparticles.[5]

## References

[1] Muñoz-Espí, R.; Álvarez-Bermúdez, O. In: D. J. McClements and S. M. Jafari (eds.). *Nanoemulsions: Formulation, Applications, and Characterization*, pp. 477–515. Academic Press-Elsevier, 2018,
[2] Schiff, H. *Justus Liebigs Ann. Chem.* **1866**, *140* (1), 92–137
[3] Abd El Sater, M.; Jaber, N.; Schulz, E. *ChemCatChem* **2019**, *11* (16), 3662–3687.
[4] Froimowicz, P.; Muñoz-Espí, R.; Landfester, K.; Musyanovych, A.; Crespy, D. *Curr. Org. Chem.*, **2013**, *17,* 900–912.
[5] Pitre, S. P.; McTiernan, C. D.; Scaiano, J. C. *ACS Omega*, **2016**, *1,* 66–76.

# Polymer Coatings with Nanoencapsulation of Organic Phase Change Materials for Thermal Energy Storage

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In recent years, research based on the development of materials for energy storage is having a great flourishing due to the need to fulfill the growing energy demand of society.[1] In this context, phase change materials (PCM) have emerged as an attractive field. Such materials have the ability to store thermal energy in the form of latent heat during a phase change, being subsequently released when the initial phase is recovered.[2,3]

Among the different types of PCM, this work focuses on the encapsulation of solid–liquid organic PCMs, namely the alkanes hexadecane and octadecane, by using the miniemulsion polymerization technique. Such linear alkanes are attractive PCMs for a large number of applications because of their good thermal conductivity and their high efficiency in storing significant amounts of heat at temperatures close to room temperature. However, they also present problems, such as large volume changes during the phase transition or potential negative effects on the environment. The encapsulation of alkanes in polymer capsules allow for controlling volume changes, avoiding leaks, protecting the surrounding medium from negative effects, and guaranteeing the cyclability of the process.[4]

In addition to the the encapsulation of PCMs, this work also presents the preparation of different coatings embedding encapsulated PCM. The incorporation of PCMs in coatings improves the structural stability and allows for an easy application and processing on the desired surfaces. Furthermore, the application in the form of coatings increases the resistance to fracture of the material and avoids leakage of the PCMs to the direct environment.

Two types of coating have been prepared. First, polymer films were prepared by redispersing the PCM capsules in a polymer solution. Second, PCM capsules were deposited on textile fabrics and copper films by using the layer-by-layer (LbL) technique. The efficacy of the prepared nanocomposites for energy storage applications was evaluated by differential scanning calorimetry (DSC).

## References

[1] Milián, Y. E.; Gutiérrez, A.; Grágeda, M.; Ushak, S. *Renew. Sust. Energ. Rev.*, **2017**, *73*, 983-999.
[2] Shchukina, E.M., Graham, M., Zheng, Z., Shchukin, D.G. *Chem. Soc. Rev.* **2018**, *47*, 4156–4175.
[3] Álvarez-Bermúdez, O; Adam-Cervera, I; Aguado-Hernándiz, A; Landfester, K; Muñoz-Espí, R. *ACS Sustainable Chem. Eng.* **2020**, *8*, 17956−17966
[4] Peng, H; Wang, J; Zhang, X; Ma, J; Shen, T; Li, S; Dong, B. *Appl. Therm. Eng.* **2021**, *185*, 116326.

# Laser pointer activation for polimerization of paper-based devices

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Molecularly imprinted polymers (MIP) are synthetic materials with recognition sites that interact by specifically binding with a target analyte. Nowadays, MIPs are increasingly used due to their high selectivity to the template molecule as well as their versatility, stability and robustness, being a good alternative to biomolecules for the selective recognition of analytes [1]. MIPs are frequently used as selective sorbents in solid-phase extraction (SPE) cartridges. Moreover, the use of paper-based MIPs has increased in the last years because of their sensitivity, easy use, low cost and their compatibility with detection systems [2]. Usually, MIPs are synthetized by free radical polymerization (FRP), electropolymerization and photopolymerization.

In this study, a new methodology for the synthesis of paper-based MIPs based on laser pointer activation and polymerization over a nitrocellulose strip has been proposed using methamphetamine, as template molecule. The employed polymerization mixture was the template, methacrylic acid, and ethylene glycol dimethacrylate in a ratio (1:4:20), using an UV radical as initiator and different porogen solvents (acetonitrile, acetone, chloroform, tetrahydrofuran, N,N-dimethylformamide, dimethyl sulfoxide…). Photoactivation of the polymer was carried out by a commercial laser pointer of 405 nm wavelength directly pointing to the nitrocellulose piece during 10 min. Different parameters, such as piece size of nitrocellulose, type and volumen of porogen, position and height of the laser pointer, and irradiation times were evaluated in order to achieve an homogeneous and reproducible layer onto the nitrocellulose paper.

The extraction efficiency of imprinted and non-imprinted paper-based polymers was investigated using water samples containing 250 µg L-1 methamphetamine (used as a drug model), determined by ion mobility spectrometry. Several extraction parameters were evaluated, such as sample pH, extraction and desorption time, and desorption solvent. The proposed paper-based device, synthetized with a laser pointer, allowed the determination of methamphetamine residues in liquid samples by a simple and versatile strategy, with reduced reagent consumption, reduced costs, and high portability.

## Acknowledgements

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## References

[1] Regal, P.; Diaz-Bao, M.; Barreiro, R.; Cepeda, A.; Fente, C; *Cent. Eur. J. Chem*, **2012**, 10, 766-784

[2] Li, W.; Zhang, X.; Li, T.; Ji, Y.; Li, R.; *Anal. Chim. Acta,* **2021**, *1148* -238196.

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