Atomically thin layers of layered materials

VNIVERSITAT DE VALÈNCIA

R&D RESULT

Patent

Knowledge Area

- Solid state chemistry
- Nanomaterials

Collaboration

- Technology available for licensing
- Other collaborations

Ref. OTRI
201274R-Pinilla, E.

Micromechanical dry exfoliation device

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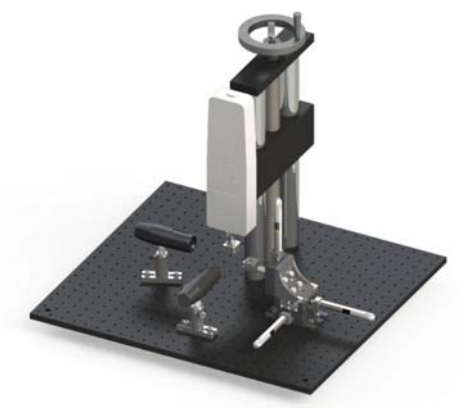
Background: After the discovery of graphene, layered materials have awakened great interest among the scientific community and in industry. Atomically thin layers of these materials present unique mechanical, optical or electronic properties, opening the possibility to develop new applications. The structural features of these materials allow for the deposition of atomically thin layers on a variety of substrates. This may be achieved for instance by the micromechanical exfoliation method, also known as "Scotch tape" method. While this procedure has been widely used for the delamination of graphite, it is limited by the small amount of material obtained and its low quality and reproducibility, which has prevented the escalation of the procedure and its application as an industrial method. There are many alternative methods to the "Scotch tape" one, however most of the dry methods require specific instrumentation and are very difficult to implement in a conventional laboratory.

The invention: Researchers at the University of Valencia have developed a new **device for dry micromechanical exfoliation of two-dimensional materials**. The great simplicity together with the relatively high efficiency of the micromechanical exfoliation approach has inspired the development of this device that includes remarkable improvements. The new method enables the exfoliation of layered materials on any surface in a clean and reproducible way. It does not produce defects in the substrate and it makes it possible to obtain larger areas of atomically thin layers and with higher flake density than those obtained by conventional methods. In particular, the new device is especially interesting for the exfoliation of some transition metal dichalcogenides (i.e. TaS_2) which are difficult to delaminate using the traditional "Scotch tape" method.

Applications: Atomically thin layers of layered materials have many potential applications, especially in **optical and electronic industries**. The device is applicable to **delamination and production of atomically thin layers of any layered material**, highlighting the good results obtained for particular metal dichalcogenides such as TaS_2. Other examples of materials that could also be delaminated are graphite, mica, layered materials with intercalation compounds, etc.

Advantages: The main advantages provided by the invention are:

- **Versatility**: the method is applicable to any layered material and on any type of substrate.
- **Simplicity**: the method consists in a dry exfoliation without adhesive materials.
- **Quality and reproducibility**: the exfoliation is clean (no trace of adhesive), reproducible and it does not produce defects in the substrate.
- **Efficiency**: it is possible to deposit a high density of atomically thin layers of the material.
- **Control**: it is possible to control the pressure exerted, allowing for a fine-tuning of the deposition conditions depending on the nature of the layered material manipulated.



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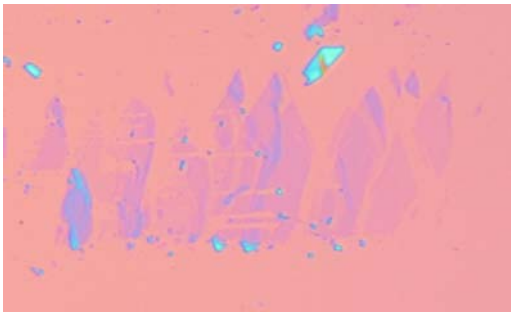

TaS_2 monolayers on SiO_2 substrate.

OTRI oficina de transferència de resultats d'investigació

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