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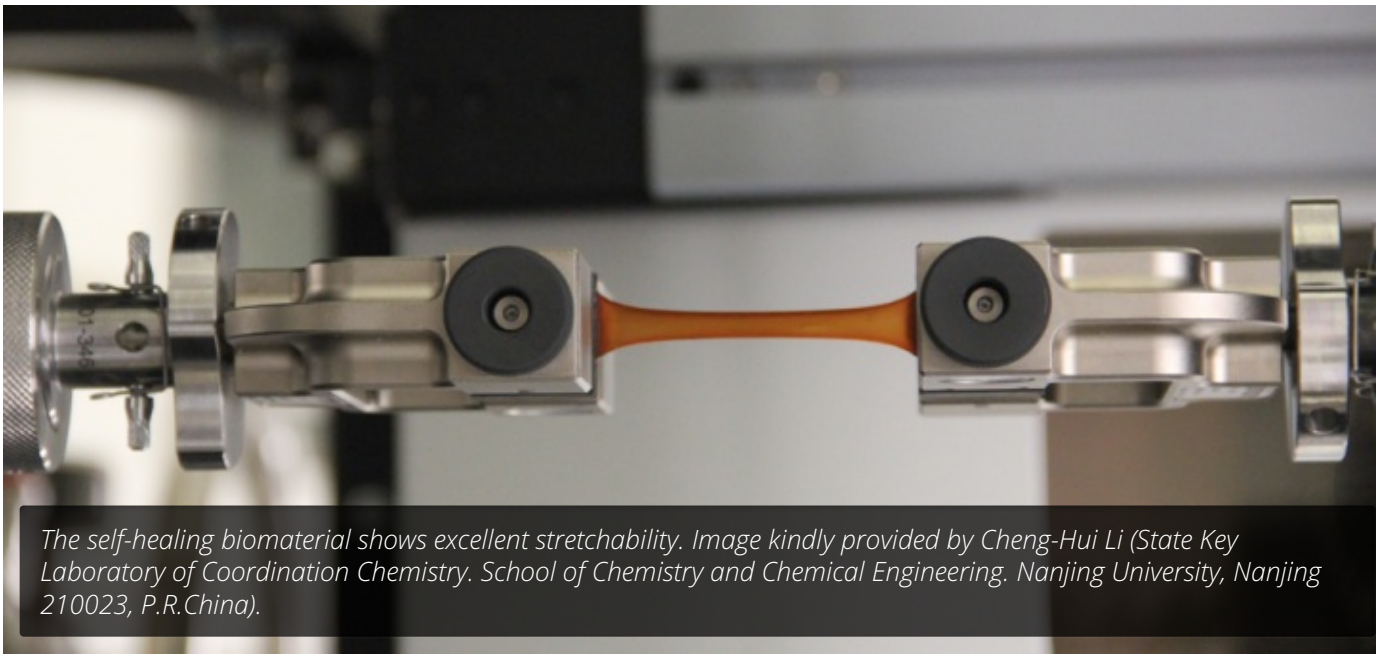
# COMMENTARY – Stretch and heal: new elastomer self-heals when damaged



*The self-healing biomaterial shows excellent stretchability. Image kindly provided by Cheng-Hui Li (State Key Laboratory of Coordination Chemistry. School of Chemistry and Chemical Engineering. Nanjing University, Nanjing 210023, P.R.China).*

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**Commentary to** *A highly stretchable autonomous self-healing elastomer* (Li, et al. *Nat Chem*, **2016**, 8: 618).

Animal muscle is a natural biomaterial with remarkable properties: it is strong, elastic and able to undergo self-healing when damaged. Even though several polymers have been designed to mimic the behaviour of muscle, these characteristics have proven tough to mimic, and no material has been able to fulfil the existing gap in muscle tissue engineering. Therefore, it remains a challenge to synthesize materials that possess the properties of biological muscles.

A recently published paper by Cheng-Hui Li and co-workers describes a new stretchable elastomer, capable of self-healing without any energy input and independently of moisture conditions[1]. This material takes advantage of the versatility offered by metal-ligand interactions to achieve high strength and self-healing at room temperature. Working with Fe (III)-2,6-pyridinedicarboxamide coordination complexes, the authors were able to combine weak bond energies with low glass-

transition temperature. Thus, strong metal–ligand binding sites are adjacent to weak binding sites in the same ligand, where weak bonds can easily break dissipating energy, whilst the stronger interactions maintain the iron ions nearby allowing rapid weak bond re-formation.

Li *et al.* reported that the dynamic nature of the metal-ligand bonds, together with the easy breakage and reforming of the weak bonds, allows the unfolding and sliding of the polymer chains, rendering the stretchability of this elastomer to 45 times its original length (see **featured image** at the top of this text). These polymers are able to restore a high dielectric strength after being damaged. Furthermore, they show excellent self-healing ability even at low temperatures without any additive to promote healing. Taking it all together, the authors suggest that these elastomers are promising for tissue engineering applications, as smart and functional biomaterials.

It is undeniable that the design of new biomaterials is a growing field with potential impact in biomedicine, and this new elastomer could play an interesting role in this process. To this aim, there are some questions that still need to be addressed in order to improve the properties of this material. The natural following experiments would involve the study of its biocompatibility, both in cell culture and in animal models. Furthermore, related to some of the experimental results, it would be interesting to study the response of the material to the dielectric current of 11 kV, the one applied in the report, while it is still damaged. This could provide information for the use of the elastomer in tissue regeneration. It would also be useful to test if the material is able to respond to currents similar to the ones occurring in the muscles at physiological conditions (e.g -90 mV in cardiomyocites[2]).

Although this autonomous self-healing elastomer does not fully recapitulate yet the properties of animal muscle, it holds great promise for biomedical and tissue engineering, opening a door for future applications. Additional research will be essential to determine to what extent it may find room for use in the clinic.

## References


1. Li CH, *et al.* "A highly stretchable autonomous self-healing elastomer". *Nat Chem*, **2016**, 8: 618. DOI:10.1038/nchem.2492.
2. Nerbonne JM & Kass RS. "Molecular physiology of cardiac repolarization". *Physiol Rev* **2005**, 85: 1205. DOI: 10.1152/physrev.00002.2005.


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