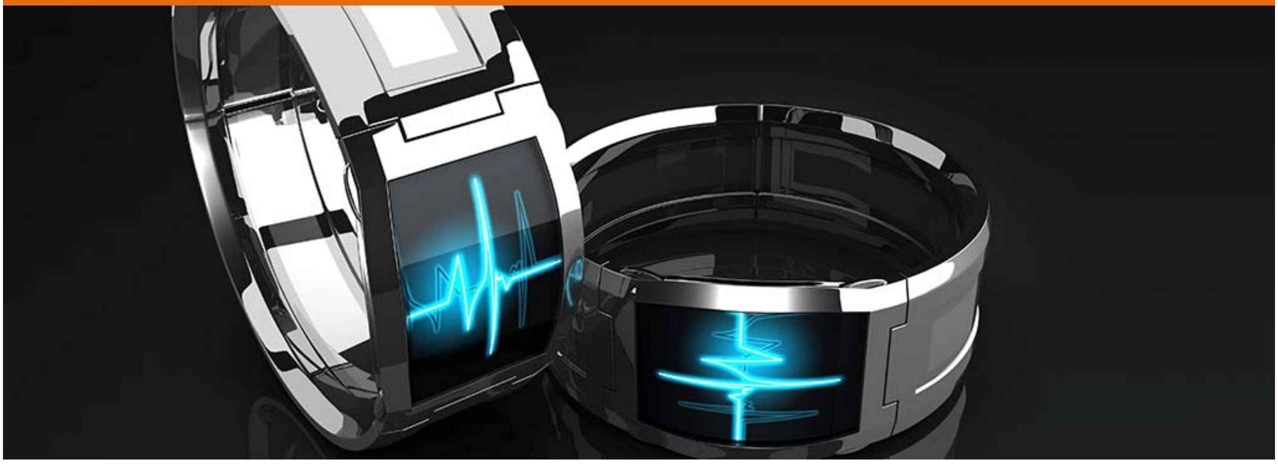
Highly Tough and Stretchable Polymer Networks
Elastic, conductive polymers for flexible solutions



Professor Oren A. Scherman and his team in the Melville Laboratory for Polymer Synthesis, Department of Chemistry, University of Cambridge, have developed a new highly tough and stretchable polymer hydrogel material capable of self healing and exhibiting ionic conductivity, with unique flexibility in its molecular design. This could potentially enable a new generation of flexible electronics and innovative materials for biomedical applications. The team is now keen to discuss the potential for this material with interested commercial parties.

Key Benefits

- Lower sheet resistance than existing electronic conductors, such as silver nanowires, graphene and indium tin oxide
- Highly elastic and significantly scratch/notch resistant
- Self-adhesive due to presence of sacrificial bonds and self-healing properties
- Easy room temperature fabrication allowing for a wide range of monomer compositions and scale-up

Oren A. Scherman is the Professor of supramolecular and polymer chemistry in the Department of Chemistry, at the University of Cambridge. His research has led to numerous awards including the RSC Hickinbottom Award in 2013 and the Cram Lehn Pedersen Prize in Supramolecular Chemistry in 2014.

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What problem does this material solve?

As shown in Figure 2, our hydrogel is conductive, and the conductivity is relatively insensitive to deformation. Although materials with ionic conductivity have a higher resistance than conventional electronic conductors for standard applications, this material has lower sheet resistance than existing electronic conductors such as silver nanowires, opening up a range of applications in wearable electronics that are currently unfeasible.

Applications

Alongside its unique conducting properties, the hydrogel is extremely stretchable and tough. This stretchy and flexible conducting material has the potential to overcome limitations in wearable technology, allowing designs for functions that so far have been impossible, such as wearable biosensors.

The hydrogel has remarkable self-healing properties, meaning it could be used in novel ways as an adhesive – for example, as a brand new form of building material, instead of mortar. The scratch-resistance and properties of this new material could be used for a new generation of coatings for phones, laptop computers, and cars.

Applications in biological implants and prosthetics look for desirable properties such as self-healing and cut/shear resistance. These are of interest in the development of new implants such as artificial cartilage and areas of research such as prosthetics with sensing capability. Our material demonstrates these properties and has a simple synthesis, potentially allowing it to be adapted and optimised for a range of biomedical applications.

The hydrogel also demonstrates fantastic adhesion to a wide variety of substrates, like glass, metals and woods, so could be used as a tough interlayer.

Benefits of the new composite material

In addition to providing significantly improved ionic conductivity, our hydrogel exhibits the following:

- Highly tough mechanical properties (so it can withstand repeated deformation in many applications)
- Economic and easy synthesis means a wide variety of applications could be accessible with an optimised synthesis
- Promising use as structural biomaterials, like cartilage replacement
- The combination of elasticity and conductivity leads to potential new applications

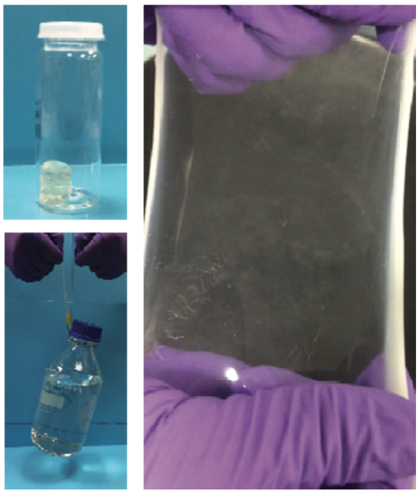

Figure 1: Demonstration of the tough and stretchy nature of the polymer hydrogel material.

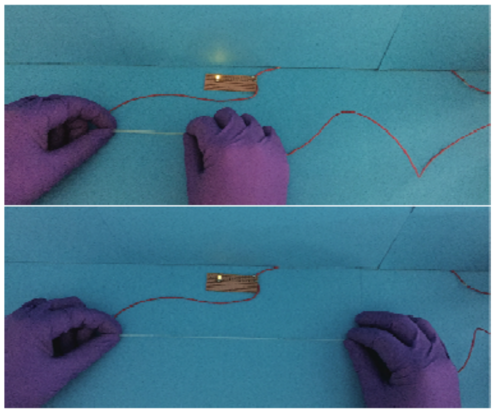

Figure 2: Demonstration of the conducting properties of the polymer hydrogel. A piece of the material is being held in place in the circuit, and the lightbulb is on.

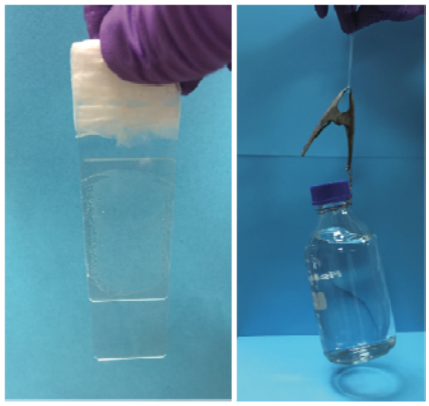

Figure 3: Adhesion of two glass slides with the hydrogel (left). The hydrogel can holding a weight up to 1.65 kg (right).

Next steps

This technology is protected by a patent application in the UK. We are now keen to discuss the potential for this material with interested commercial parties. Please contact us to explore this opportunity.