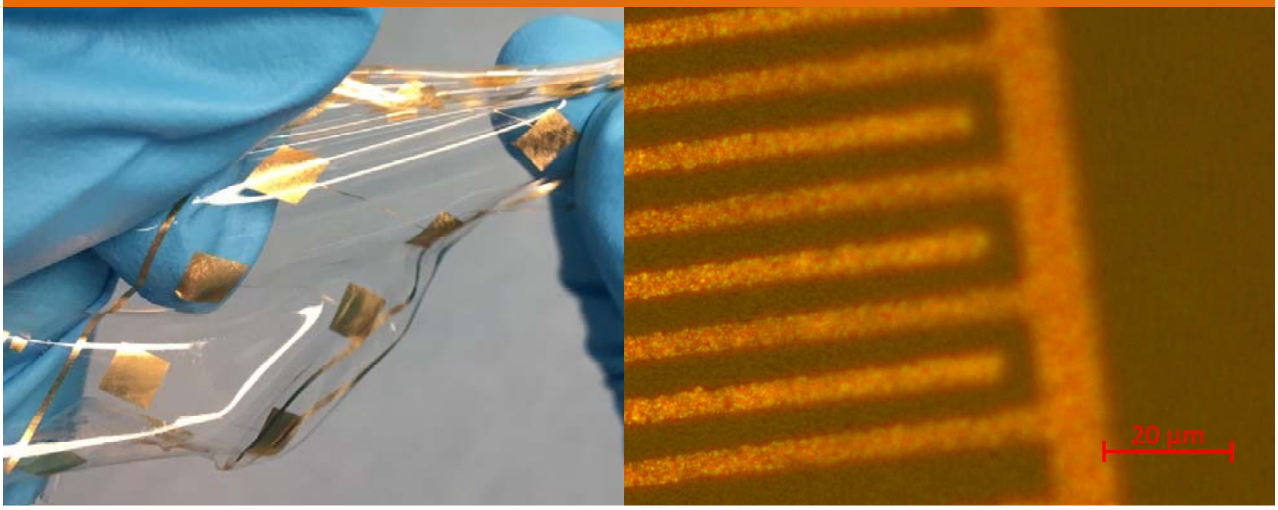
Scalable process for manufacturing high-resolution, biocompatible, stretchable electronics

50nm features with 20% stretchability



Researchers at the EPSRC Centre for Innovative Manufacturing in Large-Area Electronics (CIMLAE), University of Cambridge have developed a scalable manufacturing process for metal patterns on elastomers which addresses common industrial issues currently hindering the development of highly stretchable, high-resolution electronic devices.

Key Benefits:

- Uses mature and intrinsically scalable manufacturing methods for wearable electronics
- Chemical compatibility with common biodegradable and biocompatible polymers and elastomers
- Process can be tuned to desired level of stretchability to enable conformability to both skin and organs
- High-resolution fabrication down to 50nm features enabling small, high-sensitivity sensors

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Background

It is challenging to fabricate electrodes on soft and stretchable substrates such as biocompatible and/or biodegradable polymers and elastomers using existing techniques developed for common rigid substrates such as silicon, glass or foil.

This is due to the significantly different chemical and physical properties between these types of substrates.

Such differences generally result in production and performance issues including:

- Cracks in the substrate and/or in the electrodes;
- Limited resolution when using conventional electrode patterning methods;
- Poor adhesion of electrode materials to the substrate; and
- Low surface areas of the electrodes, leading to low sensitivity, particularly problematic for wearable or implantable bio-electronic devices such as biosensors.

The new process overcomes these issues and can be adopted rapidly as the process is compatible with conventional facilities.

Key process capabilities:

- **Control of film morphology to optimise surface area (Fig. 1) –** Advantageous for applications such as electrochemical sensors and label free detectors for increased enzymatic immobilization
- **Control of film roughness –** Enhances both the adhesion of the metal films onto the polymer and the intrinsic stretchability of the final device on top of the surface area of active electrodes
- **High resolution (down to 50 nm)** – limited by patterning technique used (e.g. e-beam lithography – Fig. 2). **Avoid toxic etchants** - only basic acid, base or salts are used
- **Highly scalable, minimal stress, simple pattern transfer** - the layer can be etched away easily after process optimisation

To date, biocompatible elastomer substrates which are suitable for both wearable and implantable applications have been successfully produced and tested (Fig. 3).

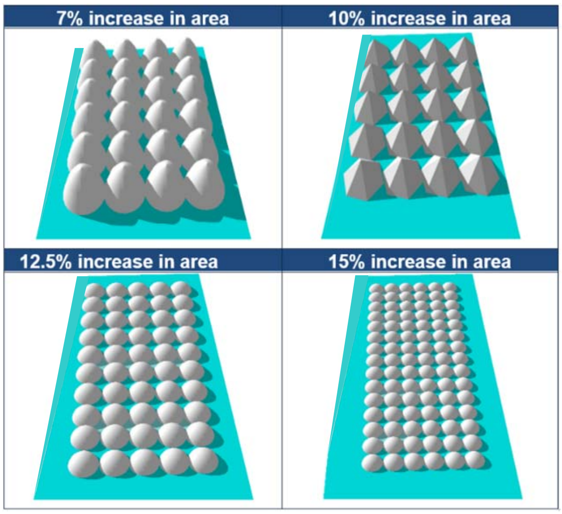

Fig. 1: Possible film morphology and the respective increase in surface area

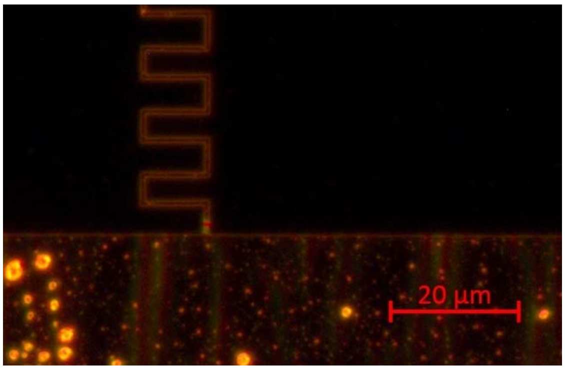

Fig. 2: High resolution device fabricated on PDMS

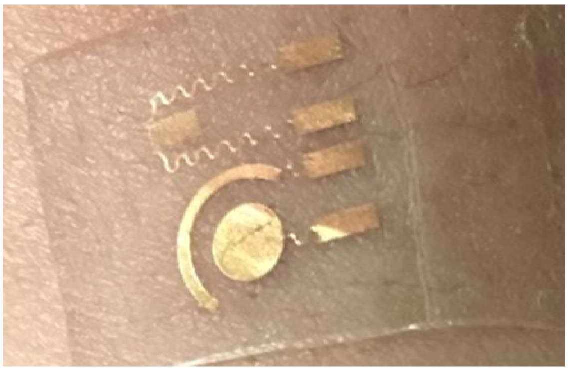

Fig. 3: Conformable and biocompatible skin sensor prototype

Commercialisation

This technology is protected by a GB patent application and we are now looking for partners who wish to scale up the process and/or develop application concepts.

If you are interested in discussing how your company can work with us, please contact us using the details on the front of this sheet.