**Conformal oxide electronics for sensing applications**

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Incorporating electronic materials into conformal platforms enables the development of sophisticated, stretchable electronic devices. Metal oxides, often processed at high temperatures, are attractive functional materials for a variety of electronic and optoelectronic applications. They exhibit stimulus-dependent transduction, and this change of state can also change functionality. Utilisation of oxides in stretchable devices has been limited due to technological challenges. Rendering oxides stretchable will be key to unlocking new fundamental properties such as envisioning strain as a new stimulus as well as to create novel high-performance conformal devices. The concept of using oxides as passive sensing elements also offers a potential solution to power hungry wearable devices.

We have created a patented transfer process1 which uses the naturally weak adhesion of platinum to silicon to render oxides stretchable. This process results in a unique ‘micro-tectonic’ surface, which is applicable to multiple oxide platforms and facilitates new stretchable device applications. This process has been demonstrated using transparent indium tin oxide2, zinc oxide3, and titanium dioxide4 thin films (all deposited at high temperatures) with stretchability of up to 15%, which is exceptionally high for a brittle oxide. The microtectonic phenomenon has been used to demonstrate gas and UV sensors and optical devices. Recently, the team have also fabricated stretchable devices using materials such as vanadium oxide and strontium titanate5 which unlocks novel applications with multi-stimuli sensing and memory devices.

The presentation will cover the challenges faced and overcome, device performance, insights obtained and new opportunities which are presented through these stretchable oxide based electronic devices.

**References**

1. P. Gutruf, S. Sriram, and M. Bhaskaran, “A flexible or stretchable sensor for use in detecting a substance and/or electromagnetic radiation and a method for detection thereof,” Australian Patent Application 2016203718 (Filed: June 03, 2016); US Patent Application 15/173,272 (Granted)
2. P. Gutruf, C. M. Shah, S. Walia, H. Nili, A. S. Zoolfakar, C. Karnutsch, K. Kalantar-zadeh, S. Sriram, and M. Bhaskaran, “Transparent functional oxide stretchable electronics: Micro-tectonics enabled high strain electrodes,” NPG Asia Materials 5 e62 (2013).
3. P. Gutruf, E. Zeller, S. Walia, H. Nili, S. Sriram, and M. Bhaskaran, “Stretchable and tunable microtectonic ZnO-based sensors and photonics,” Small 11 4532 (2015).
4. P. Gutruf, E. Zeller, S. Walia, S. Sriram, and M. Bhaskaran, “Mechanically tunable high refractive index contrast TiO2–PDMS gratings,” Advanced Optical Materials 3 1565 (2015).
5. M. A. Rahman, T. Ahmed, S. Walia, S. Sriram, and M. Bhaskaran, “Oxygen-deficient strontium titanate based stretchable resistive memories,” Applied Materials Today 13 126 (2018).