# MASSIVE Newsletter

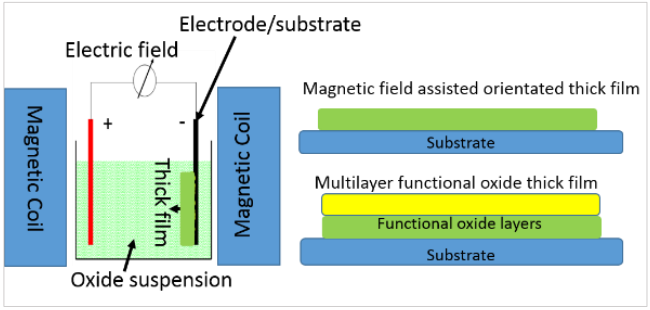
## MAnufacture of Safe and Sustainable Volatile Element Functional Materials

**No. 5 | May 2016**

## Update on MASSIVE Manufacturing Capability Projects

Research at the MASSIVE university partners underpinning the process of scale-up from lab to industry is organised into a number of Manufacturing Capability Projects (MCP), focusing on different aspects of the synthesis and characterisation of powder and bulk substitute functional materials and the development of cost-effective and sustainable deposition methods.

The focus of researchers based at **Queen Mary University of London** is on using environmentally sustainable technologies to fabricate functional oxide thick films with improved properties for a wide range of applications including capacitors, fuel cells, heat spreaders, sensors, actuators, transducers and biological instruments. Electrophoretic Deposition (EPD) has been selected from the various thick film fabrication techniques available due to its low cost, simplicity in design and the ability to cover complex structures conformally with layer thicknesses of 2-50 µm. Deposition is carried out via application of an AC or DC electric field to a colloidal solution of the oxides and can be extended to fabricate multilayer structures. The QMUL team are also looking at using magnetic field assisted deposition, resulting in the preferential orientation of the deposited oxide layer with enhanced properties (shown schematically above). Magnetic assisted deposition promises to give the edge over conventional EPD and could lead to a revolution in the field of thick film fabrication techniques.




The group at the **University of Surrey** is currently looking at routes for formulating thermoelectric (TE) inks for printing of layered structures and devices. In a collaboration with the team at the **University of Manchester**, Surrey has produced strontium titanate inks and has successfully screen printed multi-layer films for TE characterisation at Manchester. Another promising TE material with the potential to offer high thermopower and high thermal stability is sodium cobalt oxide. Surrey is addressing the issue of preventing the loss of volatile sodium during processing at elevated temperatures, with a consequent effect on composition and properties, by synthesising sodium cobalt oxide via a molten salt synthesis route within a sodium rich environment. A bismuth telluride ink has also been produced using a novel environmentally friendly process - as compared with the standard route - which has been optimised for inkjet printing onto flexible substrates, work which forms part of an aligned collaboration with MASSIVE industry partners European Thermodynamics Ltd on the Innovate UK **ENHANCED** project.

## Innovate UK 'GraphTED' project

European Thermodynamics Ltd are also collaborating with Professor Robert Freer and colleagues at the University of Manchester on the Innovate UK **GraphTED: Graphene nanocomposite materials for thermoelectric devices** project, running from April 2015 to May 2016. The aim of GraphTED is to develop cost-effective thermoelectric (TE) devices with improved properties over a wide range of temperatures (50-500°C) by adding graphene to conventional oxide TE materials, for use in energy harvesting applications such as waste heat recovery from automotive exhaust gas. **Further information**: **graphted.co.uk**.

## Sustainable Functional Materials SFM2016 Conference

Beachside fish and chips and dramatic views from the castle mount were enjoyed by the 60+ attendees gathered in Scarborough in early April for the inaugural **SFM conference**, co-organised by EPSRC-funded projects **SUBST** (led by the University of Sheffield) and **MASSIVE**. The meeting brought together the two projects' academic teams and generated plenty of lively discussion, with an international audience and keynote speakers including Jon Booth (Johnson Matthey) who gave a valuable industrial perspective on manufacturing with sustainable functional nanomaterials. The next SFM conference will be held in 2018.

### Conferences & Events

**Energy Harvesting 2016**
Energy Harvesting Network annual dissemination event, 11 May 2016, London

**ICT/ACT 2016**
35th International/1st Asian Conference on Thermoelectrics, 29 May – 2 June 2016, Wuhan, China

**EPSRC Thermoelectric Network Meeting and Training Event**
13-14 Sept. 2016, University of Glasgow

**ECT2016**
14th European Conference on Thermoelectrics, 20-23 Sept. 2016, Lisbon, Portugal

### Collaborate with MASSIVE

The MASSIVE project team is continually looking to grow its **industrial engagement** through maintaining an active industrial advisory group, expanding its industry partner base and developing new collaborative projects. Co-funding from MASSIVE is available for collaborative projects with industry, including short-term Feasibility Studies enabling exploration of novel manufacturing concepts and evaluation of their potential to lead to longer-term strategic Industry Development Projects. Please contact us if you are interested in discussing how we can work together.

### Contact Us

Prof Robert Dorey
MASSIVE project lead
**r.dorey@surrey.ac.uk**
+44(0)1483 689608

Lynn Boniface
MASSIVE liaison
**l.boniface@surrey.ac.uk**
+44(0)1483 682359

**www.surrey.ac.uk/massive**