

Project news



Metrology for Energy Harvesting project partners from the **National Physical Laboratory** and **Physikalisch-Technische Bundesanstalt** will be presenting a masterclass workshop at *Energy Harvesting and Storage Europe 2013* in Berlin in April.

The Masterclass is being developed in association with *IDTechEx* and aim is to give industry specialists a much needed grounding in metrology to underpin the development of new materials and devices with increased energy output. It's also a great opportunity for project partners to come into contact and engage with relevant industry users.

NPL's Dr Paul Weaver will present a module on a piezoelectrics whilst PTB's Dr Ernst Lenz will look at thermoelectric energy harvesting from a metrological point of view.

As part of our involvement, project partners have been offered a 30% delegate discount to promote the event and our Masterclass workshops in particular to our supporters and their own communities. In order to get this discount, please use the promotional code – MET3 when signing up [here](#).

A paper by Dr Ernst Lenz and colleagues from **Physikalisch-Technische Bundesanstalt** was published in the November issue of *physica*

status solidi (c), the conference proceedings of the Fifth International Conference on Optical, Optoelectronic and Photonic Materials and Applications (ICOOPMA12). The paper is titled *Traceable measurements of electrical conductivity and Seebeck coefficient of β -Fe_{0.95}Co_{0.05}Si₂ and Ge in the temperature range from 300 K to 850 K.*

It describes a system to measure the Seebeck coefficient and the electrical conductivity of different bulk materials. Some improvements of the original setup allow a reduction of the achievable relative measurement uncertainty regarding the Seebeck coefficient to a few percent. This is demonstrated by the results of Seebeck coefficient measurements of a metallic-alloy and different semiconducting samples.



Fig 1. A wad shaped (b) differential thermo-couple (DTC) [as intermediate state in the development], one of several used within the SR5 – System developed by Dr. Ernst Lenz and his colleagues at PTB that include planar shaped (a) and in the final stage point shaped (c) examples. All stages [b), c)] are accompanied by a reduction of the electrical uncertainty by simultaneously preserving good thermal contact.

The paper can be downloaded from [here](#).

Visit our homepage at http://projects.npl.co.uk/energy_harvesting

Project news

A recent paper written by researchers from the **National Physical Laboratory** and Queen Mary, University of London presents a novel ZnO nanorod device that generates a piezoelectrically-induced voltage of 10 mV, and a current of $10 \mu\text{A cm}^{-2}$.

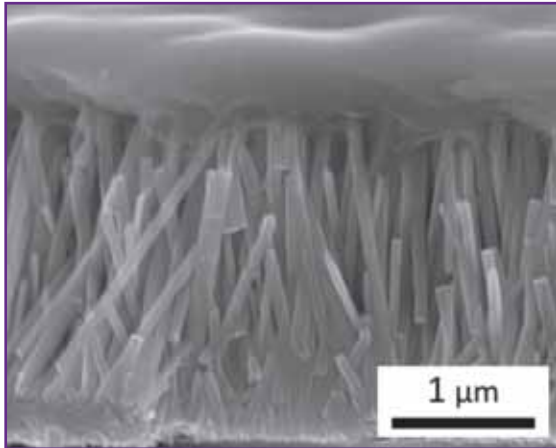


Fig 2. Cross section of ZnO nanorods on indium-tin oxide (ITO)-coated polymer substrates and ZnO-PEDOT:PSS device

The nanorods were grown on a flexible substrate and combined with a p-type semiconducting polymer. Systematic testing of the devices is performed showing that the voltage output increases linearly with applied stress but is reduced significantly by illumination with ultraviolet light.

Recent results from this collaboration will be presented at the *Piezo 2013 conference* in France in March and the sixth annual *Smart Sensors, Actuators, and MEMS conference* in Grenoble, France.

The paper, titled *Nanostructured zinc oxide piezoelectric energy generators based on semiconductor P-N junctions* can be downloaded [here](#).

Dissemination event - At the end of last year, the project partners met to update each other on their progress and plan the remaining activities for the last year of the project. Alongside commitments to the development of industry workshops mentioned above, the meeting also saw plans put in place for a concluding dissemination event to be run later in the year to summarise key project outcomes and bring together what the project has produced that can be used by industry.



Researchers from the **National Physical Laboratory** will be attending the Piezo Institute conference in France in March to present 10 papers covering a range of topics including energy harvesting, high temperature piezoelectrics, sensors and smart coatings, energy storage, electrocaloric refrigeration, nanoscale piezoelectric measurements and defects in ferroelectric materials.

As well as the Zinc Oxide nanorods work described above Dr Paul Weaver and colleagues will also present recent work on smart coatings for Tungsten Carbide-Cobalt cutting tools in collaboration with the University of Cranfield.

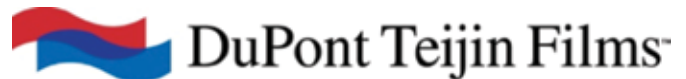
Also of interest to the project is a new collaboration with PTB, The University of Leeds, LNE, MIKES, CMI and aixACCT Systems GmbH on "*Electro-thermal coupling and new functional materials technology*" that will present work from a recently started EMRP project on high temperature piezoelectrics and electrocaloric cooling (<http://projects.npl.co.uk/METCO>)

Further details on the conference and how to register your place can be found [here](#).

Alexandre Bounouh and colleagues from the **Laboratoire national de métrologie et d'essais** have submitted an abstract to *IMEKO TC-4*, the Symposium on Measurements of Electrical Quantities which will take place in Barcelona, Spain, on 18th and 19th July. The presentation will focus on new developments in the group's harmonic distortion method to characterize the mechanical properties of MEMS based energy harvesters.

View from industry:

Bill MacDonald, Business Research Associate at DuPont Teijin Films



Who are DuPont Teijin Films?

DuPont Teijin Films is the world's leading differentiated producer of innovative and high quality PET and PEN polyester films. It is a 50:50 global joint venture between DuPont, the US chemical company and Teijin, a Japanese chemical and pharmaceutical company.

What is your role?

I am a Business Research Associate (senior scientist) at DuPont Teijin Films, though I actually started at ICI Plastics Division looking at advanced materials and primarily liquid crystal polymers. I eventually moved into the Polyester Films Business which subsequently was sold to DuPont.

My role is to look at the next generation of technologies that might be of relevance and interest to the films we produce. Areas of active research include developing substrates for flexible electronic and PV applications and in understanding the material requirements required for this emerging industry.

What market do you sell into?

We are fairly unusual as we supply such a wide range of market types. Packaging remains a major market for us but increasingly our focus is on specialty film markets including medical test strips, cards and labels, imaging applications, insulation in motors, membrane touch switches, printed electronics and building and construction.

Most relevant for energy harvesting is our range of films tailored to the photovoltaic market which is a big market for us and we are closely following commercial opportunities for flexible solar cells. We believe our films will have an important part to play

in tomorrow's flexible solar cells where they will act as the substrate on which to deposit the active PV layer and in the front and backsheets of the modules.

We are also interested in the potential for energy harvesting and piezoelectric structures which could harvest movement to potentially drive sensing devices.

What is the current status of this line of research?

It has been pushed to one side at the moment. We have had several attempts at trying to get funding from the UK government's Technology Strategy Board to explore it further in a partnership that included amongst others NPL, University of Southampton and BRE. Unfortunately we have had no luck so far and as a result some of the initial enthusiasm has been lost. Having said that it still remains, waiting in the wings, for us to come back to in time.

What we lack is a demonstrator to show that our idea is sound. This would make it much easier to convince external funders and internal management that it is an idea worth pursuing. It's not something we have the technology internally to pursue so we hoped that by partnering with academic institutions and research establishments we could produce an effective demonstrator.

How have these markets changed over time?

We have to continually reinvent ourselves and the markets we target as technologies come and go. Floppy disks and video are examples of big markets for us at one time in the past which have now gone.

How has the PV harvesting market changed in recent years?

It is still a growing market but has become quite cut throat as the cost of the modules has gone down in rival countries like China which means the margins are shrinking. Having said that we still believe the market opportunities are growing sufficiently to make it an area worth pursuing.

Is this view representative of a wider trend in the energy market?

The whole energy management field is one that is going to become far more important over the next decades. As energy costs go up, cost effective alternatives to air conditioning will become more important.

Heat management in general and energy harvesting in particular is going to be a growing focus in terms of controlling the environment within a building.

Are there any other markets where you see this energy management focus becoming big?

Outside of buildings, automobile and transport are all areas looking for more efficient use of energy.

How healthy is the European commercial space in this technology?

The problem at present is you can manufacture the modules more cheaply in Asia than you can do it here. As a result we have seen a number of European companies going to the wall in recent years. The fact is the demand and volumes are still there but many simply cannot compete on price.

How important is standardisation to the commercial uptake of thin films?

Standardisation is important in terms of lifetimes, particularly for backsheets of films where you might be trying to predict lifetimes in the field of the order of 20 – 25 years.

However as we are a supplier into the backsheet market rather than a manufacturer of the backsheets themselves we tend to concentrate on the specifications asked of us for our films although we have to be aware the property set that the module has to pass.

Upcoming events

Energy Harvesting 2013 (Energy Harvesting Network Dissemination Event)

25th March
London, UK

3rd National conference on Energy Harvesting - JNRSE'2013

27th - 28th of March
Washington, DC

Printed Electronics Europe 2013

17th - 18th April
Berlin, Germany

Energy Harvesting & Storage Europe 2013

17th - 18th April
Berlin, Germany

Wireless Sensor Networks & RTLS Europe 2013

17th - 18th April
Berlin, Germany

IMEKO TC-4 Symposium on Measurements of Electrical Quantities

18th - 19th July 2013
Barcelona, Spain

We welcome feedback, opinion and suggested articles. Please send your comments to paul.weaver@npl.co.uk and james.romero@proofcommunication.com

This project is funded by the EMRP and national metrology research programmes.

EMRP

European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

