

## Welcome

Welcome to the 3rd newsletter from the PETMEM Consortium – keeping you up to date with our activities and general topics of interest. We are on twitter, follow us @petmem2020 to receive all the latest updates.

## The PETMEM Project

PETMEM (Piezoelectronic Transduction Memory Device) is a European Commission funded project under the H2020 ICT Programme. Our project objectives include a proof-of-concept demonstration of a new low-voltage memory element and high speed RF switching chip by employing new functional materials and novel nanoscale structures. The innovation outputs from this project will increase EU market share in the production of piezoelectric transduction devices and systems. The PET technology transduces voltage to stress, activating a facile insulator–metal transition, thereby achieving multi-GHz switching speeds, as predicted by modelling, at lower power than the comparable generation field effect transistor (FET).

## Highlights to date

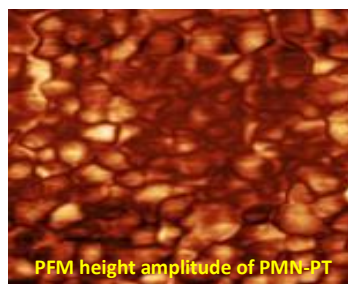
The PETMEM consortium was at IBM Zurich, Switzerland on the 8th and 9th of December 2016 for our Month-12 consortium meeting. On the 15th of December 2016, the EC reviewed the PETMEM project in Brussels where



feedback and comments were positive. A key recommendation from the review meeting was centred around post-project exploitation and the alignment of the project strategy with

those of the target industries. The consortium, led by Electrosciences & BNC, has invited several industrial players to join our industrial advisory board (IAB) with the purpose of understanding the needs of industries and how we can better align the project approach to meet these needs. The PETMEM IAB meeting was held on the 15th May 2017 in London with contributions from players in both the memory and RF switching industries.

Since the Brussels meeting, NPL has conducted a study to determine the suitability of Piezoresponse Force Microscopy (PFM) as an inline process control tool to characterize piezoelectric materials. They concluded that PFM does not appear to be suitable for this purpose. This means that our main characterization tool for PE materials is the optimized DBLI (double-beam laser interferometer) which aixACCT has integrated for performance assessment



## PETMEM was at:

Our partners attended the following events in the last 6 months:

**December 16, 2016: Invited Seminar at IMEC, Leuven Belgium.**

**April 6, 2017: Compound Semiconductor Simulation & Modelling Conference, Birmingham, UK.**

**April 17-21, 2017: MRS Spring Meeting and Exhibition, Arizona, USA.**

**April 19-21, 2017: IOP's Dielectrics 2017 conference. NPL, Teddington, UK.**

**May 7-11, 2017: IEEE International Symposium on Applications of Ferroelectrics (ISAF), Atlanta, GA, USA.**

**May 10, 2017: Invited Seminar – Hartree Centre, STFC, Daresbury, UK.**

**May 19-22, 2017: Piezo2017 - Cercedilla (Madrid) SPAIN.**

## Meet the PETMEM Team

Our partners will be at the following events in the next 6 months:

**June 15-16, 2017: PETMEM Month-18 Consortium meeting at MPG Dresden, Germany.**

**June 26, 2017: PETMEM mid-term review meeting at DCA Turku, Finland.**

**July 17-21, 2017: SCES 2017 at Clarion Congress Hotel, Prague, Czech Republic.**

**September 20-21, 2017: 20th anniversary of the opening of the XMaS beamline - Grenoble, France.**

of unclamped piezoelectric films with structure sizes of  $2\mu\text{m}$  or below. Significant progress has been made on the deposition of both Piezoelectric (PE) and Piezoresistive (PR) functional materials on suitable substrates for generations - 1 & 2 of the PETMEM device. SINTEF has performed the deposition of PMN-PT thin films on the STO templated wafers made by IBM. This was implemented using their in-house PiezoFlare 800 pulsed laser deposition (PLD) tool on 150 mm wafers.

Also, the University of Gent has altered the back-switching behaviour in thin films (which does not occur spontaneously on release of pressure as is the case in single crystals) by alloying Sm with other rare earths elements (such as Eu, Gd). They studied the structural and optical properties of a relatively wide range of Sm<sub>1-x</sub>RE<sub>x</sub>S compounds where those showing hysteresis will be chosen for deposition on 150 mm wafers with epitaxial PMN-PT from SINTEF. MPG has developed a set of new functional materials with focus on two types of mixed valence compounds (MVC). They employed high throughput DFT to analyse the bandgap variations of MVCs under pressure (both uniaxial and hydrostatic). This was followed by thin film synthesis and the high-pressure experiment on both bulk and thin film samples. Scientists, Dr Nick Chadwick (BNC) and Dr Sergey Medvedev (MPG) have been investigating the hysteretic properties of the SmS samples from UGent with useful insights already gained now by the initial results.



Nick & Sergey @ MPG, GE

BNC and Electrosiences are collaborating with Poet-in-the-city and Aurora Orchestra to deliver a PETMEM Public Engagement event in London on the 15th of October 2017 and later in January 2018. The key objectives are to



PETMEM engaging with artists @ NPL, UK.

use the arts to create an engaging conversation about the complex science involved in the PETMEM technology and to engage the general public with key ethical questions relating to increasingly efficient energy consumption and the many likely futures for memory storage. We will create a new artistic commission including

poetry and music for a public performance and roundtable debate of issues arising from the engagement. Electrosiences is leading the exploitation of the PETMEM technology with an initial market analysis and business plan. We will adjust the project strategy and continue to work on the planned tasks during the next stages of the research.

**October 15, 2017: PETMEM Public Outreach Event at the Welcome Trust, London, UK.**

**November 26 - December 1, 2017: Materials Research Society Fall Meeting & Exhibit, Boston, Massachusetts, USA.**

The PETMEM consortium acknowledges & appreciates the support from the IOM<sup>3</sup> for hosting our Industrial Advisory Board meeting on the 15<sup>th</sup> May, 2017.

BNC and Electrosiences will engage with groups outside the scientific community through the Knowledge Quarter in heart of London and the PETMEM Interactive Experience across the EU.

## PETMEM Publications

[From NPL:](#)

M. Stamenova, R. Mohebbi, J. Seyed-Yazdi, I. Rungger, and S. Sanvito, Phys. Rev. B 95, 060403(R) – Published 7 Feb 2017

### Learn more:

Please visit our website ([www.petmem.eu](http://www.petmem.eu)) for more information about the PETMEM project and the consortium members. Please follow us on twitter (@petmem2020)