PETMEM Newsletter November 2018

Welcome

Welcome to the 6th 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

We are working to develop and characterization new materials as well as the tools required to enable the fabrication of an entirely new low-voltage, memory element and high-speed RF switching chip. This project is tackling the most important barrier currently slowing down the expected evolution of CMOS; that is the fundamental limit on the further lowering of line voltage arising from Boltzmann's law. Power, proportional to voltage squared is not lowered and hence speeding up chip operation would exceed acceptable power consumption, leading to the stasis in speed. 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

At the month-30 meeting hosted by Solmates, Enschede, Netherlands (6-7th June 2018), the partners discussed the progress made in the last 6 months with emphasis on completing our first integrated device demonstrators. On the 27th of September 2018, the PETMEM project was reviewed by the European Commission in Brussels. The expert reviewers concluded that PETMEM has achieved most of its objectives for the period under review. Key milestones planned for the period have been achieved. Overall, the project with the requested extension is in good shape and on track towards the main project objectives. The European Commission has

PETMEM partners @ the European Commission, Brussels, 2018.

formally accepted the extension of the project duration requested. SINTEF and the University of Gent have completed the deposition of Piezoelectric PE and Piezoresistive PR material for Generation-3 devices respectively. The PR thin films from UGent were characterized by NPL and Aixacct using instrumented indentation testing and blocking force

PETMEM was at:

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

July 2 - 3, 2018: 7th International conference on Smart Materials and Structures, Vienna, Austria.

July 7, 2018: Scientific meeting at Naval Research Laboratory and invited talk on 'PET Technology', Washington DC, USA.

July 9 - 12, 2018: Electroceramics XVI conference, Hasselt, Belgium

August 20-21, 2018: 20th International Conference on Electroceramics, London, UK.

August 30, 2018: CASTEP Many Body Effects Workshop", University of Oxford, UK

October 14 - 18, 2018: American Ceramic Society, Columbus, Ohio, USA.

October 22 – 25: 2018 IEEE International Ultrasonics Symposium, Kobe, Japan.

November 25-30: 2018 MRS Fall Meeting, Boston, Massachusetts, USA.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688282

techniques. An out-of-plane resistance measurement was successfully performed with simultaneous application of mechanical forces. The accuracy of force measurement can be ensured below 1 % deviation of force sensor range. Measurement cycles are automated with minimal time consumption. This ensures a reduction of environmental influences to the sample. A four-point measurement approach was implemented to further support the accuracy and reliability of resistance measurement. Solmates has developed a large scale PLD tool for deposition of PMN-PT thin films. They have refined their PLD equipment to allow for better control and reproducibility of the PMN-PT deposition process. In addition, Solmates put many efforts in the improvement of the particle density per wafer as this can be a potential showstopper for the PET device. Solmates has set up a roadmap to further improve this specification and meet other tool specific requirements in time. Also, DCA has developed a simplified MBE deposition chamber for STO wafers. The theoretical modelling work at NPL has focused on the multi-scale device modelling to complement the experimental activity in PETMEM, starting from atomic scale simulations of piezo-resist/metal interfaces, to full device modelling and design using finite element (FE) simulations, including the development of a continuum model for a simplified description of the device operation. Furthermore, Prof. Markys Cain (Electrosciences Ltd) attended MRS Fall 2018, in Boston, USA November 25-30, 2018, and presented an update of the PETMEM research project as an invited talk in the 'New Materials and Applications of Piezoelectric, Pyroelectric and Ferroelectric Materials' session. The consortium's progress was applauded by many attending the talk and offers of collaboration were forwarded by leading research labs and world leading companies, interested in our 'beyond CMOS' approach to low power, high speed electronics technology. Prof Cain also took the opportunity to update PETMEM's international scientific advisor and past president of the MRS – Professor Susan Trolier-McKinstry of Penn State University – of our research results and our plans for the coming 6 months of work. Professor McKinstry was impressed by the progress made on the development of our first demonstrator device and she was duly thanked and acknowledged for her previous ground-breaking work in all the initial work with IBM (TJ Watson) in the evolution of the Piezoelectric Transistor Technology, which PETMEM was based on. As we look forward to the next 6 months of the project, we are excited and filled with great expectations towards demonstrating a new low-voltage memory element.

Prof. Markys Cain @ MRS Fall 2018, in Boston, USA.

Meet the PETMEM Team

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

January 17- 18, 2019: PETMEM Month-36 Consortium meeting at AIXACCT, Aachen, Germany.

January 26 - 30, 2019: PIEZO 2019 Electroceramics for End Users X, Krkonoše, Špindlerův Mlýn, Czech Republic.

April 1, 2019: Industrial Advisory Group meeting, London, UK

May 1, 2019: PETMEM Workshop, London, UK

PETMEM Publications

W. H. Appelta, A. Droghettic, L. Chioncelb, M. M. Radonjic, E. Muñoz, S. Kirchnerg, D. Vollhardtd, I. Rungger, Nanoscale 10 (315), September 2018.

I. Rungger, "Non-equilibrium Green's Function Methods for Spin Transport and Dynamics", Book chapter in "Handbook of Materials Modelling", Springer International Publishing, 2018.

Learn more:

Please visit our website (www.petmem.eu) for more information. Please follow us on twitter (@petmem2020).

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