Deposition of epitaxial PMN-PT on silicon wafers for Piezoelectronic Transduction Memory Devices

M. Dekkers*[1], M. Nguyen[1], N. Hildenbrand[1], S. Abel[2], F. Eltes[2], J. Fompeyrine[2], P. Wittendorp[3]
[1]Solmates BV, Drienerlolaan 5 (building 46), 7522 NB, Enschede, The Netherlands
[2]IBM Research GmbH, Zurich Research Laboratory, Säumerstrasse 4,
CH-8803 Rüschlikon, Switzerland
[3]SINTEF Digital, MiNaLab, Oslo, Norway
Matthijn Dekkers: matthijn.dekkers@solmates.nl

It is well known that Pulsed Laser Deposition (PLD) is a very flexible and versatile technique allowing fast optimization of new and complex material thin films. The unique features of PLD allow for the integration of "Beyond Moore" materials in CMOS and new devices. Among these are $Pb(Zr,Ti)O_3$, PMN-PT, $BaTiO_3$, $LiNbO_3$ and other materials of interest for applications in ferroelectrics.

Within the scope of the PETMEM project [1] a new ground-breaking beyond CMOS computer technology will be developed that has the potential of no less than 50 to 100 times reduction of power consumption compared to current state-of-the-art. This novel Piezoelectric Transduction Memory (PETMEM) device uses a radically different switching mechanism in order to go beyond the power limits of current devices.

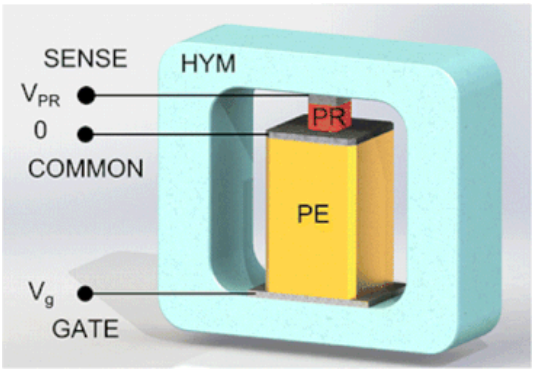

Figure 1. The piezoelectronic transistor (PET) is a transduction device not subject to the voltage limits of field-effect transistors.

High strain and long term stability of the piezoelectric material are key ingredients for successful commercialization of the piezoelectronic transduction memory. These properties are generally achieved in epitaxial films of PZT or PMN-PT. Integration of epitaxial piezo layers on silicon forms therefore an essential ingredient for the realization of these memory devices.

Using Solmates PLD platform, wafer-level integration of epitaxial thin films on silicon is demonstrated. The robust and reliable hardware allows uniform thin film deposition up to 200 mm diameter with high process reproducibility. In this contribution the deposition of epitaxial PZT and PMN-PT thin films on silicon wafers by means of buffer layers will be presented. The piezoelectrical and piezomechanical properties in relation to their crystalline quality will be discussed. The results of this work are the first milestone in the development of the piezoelectric memory.

References

[1] http://www.petmem.eu/