Minicolloque n° 17 ☒ **Oral** **Poster**

Towards epitaxial $Pb(Zr_{0.52}Ti_{0.48})O_3/La_{2/3}Sr_{1/3}MnO_3/SrTiO_3$ based resonant MEMS on Si

Laryssa M.Carvalho de Araujo[a*], Jacques Junior Manguele[b], Bertrand Vilquin[c], Zhe Wang[d], Carolina Adamo[d], Pedro Rojo Romeo[c], Christophe Cibert[b], Gilles Poullain[b], Bernadette Domengès[b], Victor Pierron[a], Darrell G. Schlom[d,e], Laurence Méchin[a]

a. Normandie Université, UNICAEN, ENSICAEN, CNRS, GREYC, Caen, France
b. Normandie Université, UNICAEN, ENSICAEN, CNRS, CRISMAT, Caen, France
c. Université de Lyon, Ecole centrale de Lyon, INL UMR CNRS5270, Ecully, France
d. Department of Materials Science and Engineering, Cornell University, Ithaca, New York, USA
e. Kavli Institute at Cornell for Nanoscale Science, Cornell University, Ithaca, New York, USA

* email : laryssa.carvalho-dearaujo@unicaen.fr

Epitaxial $La_{2/3}Sr_{1/3}MnO_3$ (LSMO) shows a ferromagnetic-to-paramagnetic transition at about 360 K that is accompanied by a metal-to-insulator transition above room temperature, which is very promising for uncooled sensors, such as anisotropic magnetoresistances or infrared bolometers [1]. LSMO also presents high sensitivity to strain, hence to mechanical effects, making it a potential candidate for resonant micro-electromechanical systems (MEMS) [2].

The objective of this work is to investigate the integration of c-axis orientated $Pb(Zr_{0.52}Ti_{0.48})O_3$ (PZT) on $LSMO/SrTiO_3/Si$, as the given chemical composition manifests the material's largest piezoelectric coefficient near the so called morphotropic phase boundary, thus enhancing actuation of the vibrant structure [3]. Four deposition methods of PZT thin films of thickness ranging from 100 to 500 nm, namely sputtering at 600 °C, sputtering at either room temperature or 300°C with post-rapid thermal annealing (RTA) treatment at 650 °C and sol-gel with post-RTA at 650 °C, were evaluated aiming a trade-off between both material quality and optimal fabrication yield.

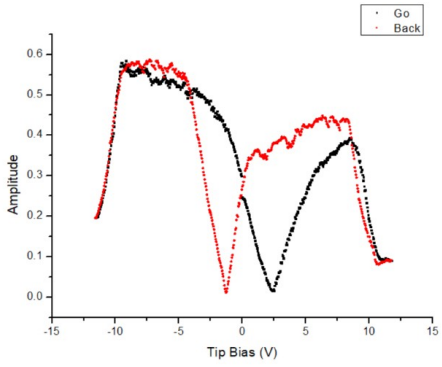

Figure 1 : Characteristic butterfly-shaped displacement versus tip voltage curve measured by PFM with a drive voltage of 3 V on the PZT thin film deposited at RT by sputtering with RTA at 650 °C.

The LSMO films of thickness in the 20 – 100 nm range were deposited by pulsed-laser deposition on $SrTiO_3$-buffered Si (001) samples deposited by molecular-beam epitaxy. The (001) orientation of the PZT layers was confirmed by X-ray diffraction, whereas the piezoelectric and ferroelectric properties were characterized by piezoresponse force microscopy (PFM), as shown in figure 1, and by polarization versus applied voltage measurements. Suspended devices were fabricated using a combination of ion beam etching in argon and reactive ion etching in SF_6 gas [4].

The dynamical properties were finally characterized using an external piezoelectrical excitation with a digital holographic microscope (DHM-R2200) and preliminary results of the full LSMO-PZT devices will be presented.

[1] V.M. Nascimento *et al.*, J. Phys. D: Appl. Phys. **54** 055301 (2021).
[2] D.T. Huong Giang *et al.*, Journal of Science: Advanced Materials and Devices, **1**, 241 (2016).
[3] S. Yin *et al.*, Thin Solid Films **250**, 4572-4575 (2012).
[4] S. Liu *et al.*, J. Micromech. Microeng. **29** 065008 (2019).