Host Laboratory: Institut de Physique et Chimie des Matériaux de Strasbourg (IPCMS)

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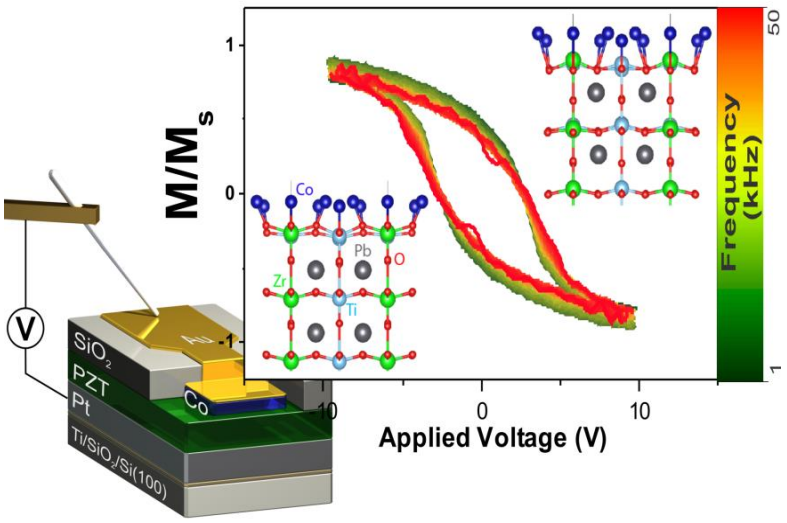
Supervisor: Dr. Salia Cherifi-Hertel

E-mail: cherifi@ipcms.unistra.fr
Phone: 03 88 10 72 18
Office: n° 1043 (IPCMS, DSI, 1st floor)

INVESTIGATION OF FERROIC DOMAIN DYNAMICS IN ARTIFICIAL MULTIFERROICS

Heterostructures that combine magnetic and electric properties are highly suited for future spintronic applications. A strong magnetoelectric coupling in artificial multiferroics like ferromagnetic/ferroelectric bilayers makes these systems particularly promising for the efficient electric-field control of the magnetization.

In such systems the coupling occurs either through strain-mediated mechanisms (converse piezoelectric effect and magneto-elastic interaction) or *via* interface-related effects (electronically driven). The latter case is particularly interesting for applications since it results in a two-state nonvolatile magnetization (see Fig.), as demonstrated in our recent study [Vla16]. Moreover, the electronic nature of the coupling suggests that the dynamic processes may be much faster compared to magnetoelastic systems, which should be limited by their mechanical clamping. In the framework of this training, we intend to explore this difference by probing the magnetoelectric coupling dynamics in two different systems: one showing a predominant strain-mediated coupling and the other primarily interface-related coupling. The role of the domain configuration and its dependence on the electric field will be investigated in the two ferroic subcomponents down to the nano-second time scale.



Figure| A rectangular magnetoelectric hysteresis loop is obtained in $Co/PbZrTiO_3$ bilayers. This hysteretic behavior traduces the existence of two magnetization states corresponding to two opposite voltage values. Moreover, the two states do not vanish when the voltage is switched off. [Vla16]

This training offers the participation to the complete study, starting from the fabrication of the magnetoelectric micro-devices (typical design shown in the Figure above) and the test of their ferroic properties, including their detailed characterization by means of advanced imaging methods in *operando* conditions.

[Vla16] O. Vlašín, R. Jarrier, R. Arras, L. Calmels, B. Warot-Fonrose, C. Marcelot, M. Jamet, P. Ohresser, F. Scheurer, R. Hertel, G. Herranz, and S. Cherifi-Hertel, "*Interface Magnetoelectric Coupling in Co/Pb(Zr,Ti)O_3*", *ACS Appl. Mater. Interfaces*, 2016, 8 (11), pp 7553–7563