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Strain-mediated manipulation of magnetization reversal in FeGa in multiferroic nanostructures

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Magnetoelastic materials are an important class of materials that are paving the way towards a new generation of multifunctional devices directly integrable into data-storage technology, energy-harvesters and spintronics[1]. Among the different magnetostrictive alloys, FeGa thin films, has received particular attention as it exhibits interesting propertiessuch as low hysteresis,large magnetostriction, good tensile strength[2] .

In this regard, the present study focuses on the strain-mediated control of the FeGa magnetization reversals (MR) for a 10 nm thin film grown onto different substrates . Firstly, the FeGa films were grown on PMN-PZT and the strain-mediated electric field control of MR was studied. It reveals a converse magnetoelectric coefficient $\alpha_{CME} \approx 2.7 \times 10^{-6}$ s m^{-1} at room temperature. This reported value of α CME is among the highest so far, compared with previous reports on single-phase multiferroics and on composites. The angular dependence of α CME will also be shown, arising from the intrinsic magnetic anisotropy of Fe-Ga. The highly efficient magnetoelectric composite Fe-Ga/PMN-PZT demonstrates drastic modifications of the in-plane magnetic anisotropy (figure 1). Secondly, FeGa film was grown on flexible aluminium kitchen foil. The strain-mediated multiaxial mechanical control of MR through the use of spherical optical lenses[4], will be presented. This work is supported by the Région Bretagne and the Institut Brestois Santé Agro Matière (IBSAM) throught the "MINOTAUR" project.

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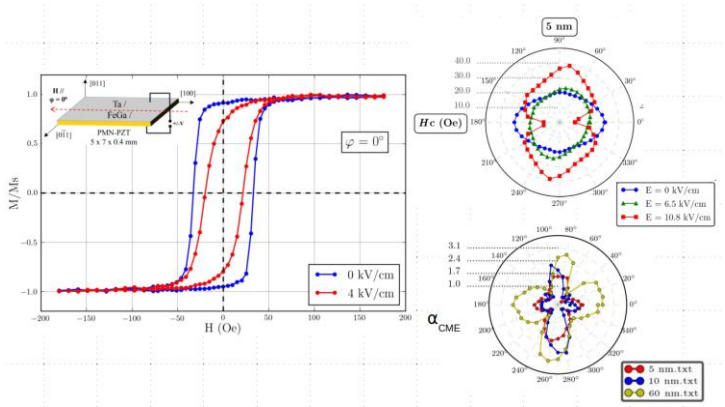

Figure 1 : Left : Hysteresis loops with and without applied electric field of Ta(10 nm)/FeGa(5nm)PMN-PZT(0.3 mm)/Cu(200 nm). Right: In-plane Azimuthal evolution of the coercive field and the converse magnetoelectric coupling coefficient α_{CME} for three electric field values