HRTEM study of $Ga_{2-x}Fe_xO_3$ thin films through doping

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Magnetoelectric materials, exhibiting a coupling between their magnetic and electrical properties, allow the manipulation of magnetization by an electric field. Such materials are interesting as they open new perspectives in terms of memory devices. For the moment the most studied room temperature multiferroic material is $BiFeO_3$. It however presents a major drawback because it does not show any net magnetization.

In this context we have studied an alternative magnetoelectric material $Ga_{2-x}Fe_xO_3$ (GFO), which presents a net magnetization at room temperature for x>1.3 [1] . Thin layers have been deposited on Yttrium stabilized ZrO_2 or $SrTiO_3$ substrates by Pulsed Laser Deposition. HRTEM study shows that GFO crystallizes in the $Pc2_1n$ structure (isostructural to ε-Fe_2O_3) and presents between 3 and 6 in-plane variants, depending upon the substrate. The lateral size of the columnar crystallites does not exceed 20nm. Dopants, such as Mg, Ni or Gd, have been successfully introduced in these films in order to overcome the leakage currents and multiferroicity and magnetoelectricity have been demonstrated [2]. However, the local structure at the interfaces between grains and between the substrate and the GFO layer still remains unclear and will be the object of this presentation.

[1] "Room temperature ferrimagnetic thin films of the magnetoelectric $Ga_{2-x}Fe_xO_3$", M. Trassin, N. Viart, G. Versini, S. Barre, G. Pourroy, J. Lee, W. Jo, K. Dumesnil, C. Dufour, and S. Robert, Journal of Materials Chemistry **19,** 8876 (2009).

[2] "Room temperature multiferroicity in $Ga_{0.6}Fe_{1.4}O_3$:Mg thin films", A. Thomasson, S. Cherifi, C. Lefevre, F. Roulland, B. Gautier, D. Albertini, C. Meny, and N. Viart, Journal of Applied Physics **113,** 214101 (2013).