Magnetic Ion Partitioning in Multiferroic Aurivillius Bismuth Iron Manganese Titanate

L. Keeney[1], A. Faraz[1], M. Schmidt[1], C. Downing[4], V. Nicolisi[4], M.E. Pemble[1, 2], R.W. Whatmore[2,3*]
[1]Tyndall National Institute, University College Cork, 'Lee Maltings', Dyke Parade, Cork, Ireland
[2] Department of Chemistry, University College Cork, Cork, Ireland
[3]Department of Materials, Imperial College London, London, SW7 2AZ, United Kingdom
[4]Schools of Chemistry and Physics, CRANN, AMBER, Trinity College Dublin, Dublin 2, Ireland
*Roger Whatmore: r.whatmore@imperial.ac.uk

Single-phase, RT ferroelectric (FE) / ferromagnetic (FM) multiferroics are needed for applications in data storage. We have made layered Aurivillius oxide films accommodating both FE and FM cations by chemical solution deposition (CSD) and liquid injection chemical vapour deposition (LICVD) and demonstrated that 5- perovskite-layer $Bi_6Ti_3Fe_{1.5}Mn_{0.5}O_{18}$ (B6TFMO) films are genuine, single-phase multiferroics in which magnetic fields can switch ferroelectric domains. Atomic resolution Nion ultra-STEM analyses have been performed on the materials (Fig 1) and these show that the magnetic cations (Mn and Fe – MC's) partition to the central three of the five perovskite layers, with Mn showing a much stronger preference than Fe for the central layer (Fig 2). In addition, the local distribution and partitioning of the MC's are markedly affected by defects such as local 4 and 6 layer regions and out-of-phase boundaries (OPB's), being reduced in the former and more strongly localized in the regions between the latter. The potential reasons and a model for this partitioning based on Boltzmann will be presented and its implications for multiferroicity discussed.

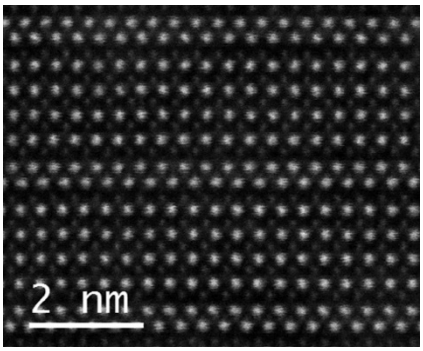

Fig. 1: HAADF-TEM image of B6TFO

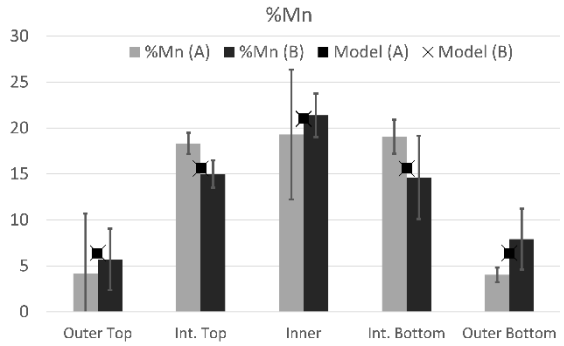

Fig 2: Mn at % variation across Aurivillius layers