Magnetic Field-Induced Ferroelectric Switching in Multiferroic Aurivillius Phase Thin Films at Room Temperature

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With the seemingly inexorable increase in the use of devices designed to access the internet for an ever increasing series of applications there is a constant need for data storage technologies with higher densities, non-volatility and lower power consumption[1]. Single-phase, room temperature magnetoelectric multiferroic materials are of considerable interest for such applications[2]. However, materials that are both multiferroic and magnetoelectric at room temperature are very unusual[3]. By inserting magnetic ions into Aurivillius phase, layer-structured ferroelectric materials , we have synthesised thin films of average composition $Bi_6Ti_{2.8}Fe_{1.52}Mn_{0.68}O_{18}$ (B6TFMO) by a chemical solution deposition process on *c*-plane sapphire substrates[4]. Piezoresponse force microscopy (PFM) demonstrates room temperature ferroelectricity. Superconducting quantum interference device (SQUID) magnetometry reveals a distinct room temperature ferromagnetic signature (M_s = 0.74emu/g, H_c = 7mT at 300K) in the films. The results of a careful microstructural analysis of the materials will be discussed. This investigation, coupled with the use of a statistical analysis of the data, allows us to conclude that ferromagnetism does not originate from unobserved second phase ferromagnetic inclusions, with a confidence level of 99.5%. Direct PFM evidence of the switching and formation of a ferroelectric polarisation induced by a change in magnetic field within individual Aurivillius phase grains will be presented[4]. This is the first report of such an effect occurring in a genuine single-phase material at room temperature in thin film form. This room temperature single phase magnetoelectric multiferroic material is currently being optimised and assessed for device-level performance and could find application in a wide range of new or improved devices to potentially meet future industry requirements in high density memory applications.

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References

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