Direct Evidence of Spin Cylcoid in Strained Nanoscale Bismuth Ferrite Thin Film

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Magnonic devices in micro- and nanostructured ferromagnetic materials have recently attracted tremendous attention[1]. To realize magnonic devices, a strong long-range spin cycloid with well-known direction is desired, since it is a prerequisite for the magnetoelectric coupling[1]. Bismuth Ferrite (BFO) is one of the most studied multiferroic material as it possesses superior ferroelectric properties and a cycloidal magnetic order in the bulk, and thus shows potential for magnonic applications[2]. However its applicability as a magnonic material, particularly in thin film form has been stymied as the stabilization of a large-scale uniform spin cycloid in nanoscale (100 nm) thin $BiFeO_3$ films has been challenging[3]. This presentation demonstrates the existence of cycloidal spin order in 100 nm $BiFeO_3$ thin films through the careful choice of crystallographic orientation, and control of the electrostatic and strain boundary conditions. Neutron diffraction, in conjunction with X-ray diffraction, reveals an incommensurate spin cycloid with a unique $[11\bar{2}]$ propagation direction. While this direction is different from bulk $BiFeO_3$, the cycloid length and Néel temperature remain equivalent to bulk at room temperature. It appears in published form in ref[4]. The research was supported by ARC Discovery Project and John Stocker Graduate Fellowship program.

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