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Helimagnetic Order in MnGe Thin Films Probed by RXMR

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MnGe is a cubic helimagnet belonging to the B20 family of compounds known to host skyrmion phases. MnGe exhibits the shortest helical wavelength among these compounds that varies between 3 nm at low temperature, up to 6 nm at the ordering temperature near 200 K. While skyrmions have not been observed in this material, there are reports of a unique topological magnetic phase consisting of localized three-dimensional spin textures called spin-hedgehogs at low temperature [1]. Other studies claim that this phase is not topological, but rather a multi-domain helical state [2,3].

We present a study of MnGe(111) films where the thickness is comparable to the helical pitch. In this thickness limit, the twisting of the magnetic textures at the surfaces play an important role in the stability of the magnetic phases. The growth of MnGe films was facilitated by the development of atomically smooth non-magnetic B20 CrSi buffer layers on Si(111) substrates, which replaced the need for the magnetic B20 MnSi or FeGe layers used by others [1,2]. MnGe films with thicknesses between 2.5 nm and 23 nm were measured by resonant X-ray magnetic reflectometery (RXMR). For the thicker films, RXMR shows helical magnetic order that has a wavelength that is shorter than bulk, and with wavevector along the film normal. At low temperature, no evidence of topological textures was found. For film thicknesses below 9 nm, we discovered evidence for a reorientation of the helical state from out-of-plane to in-plane, revealing the influence of surfaces twists in this material.

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