Electronic fluctuations in the skyrmion phase of room temperature skyrmionic systems

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Magnetic skyrmions, which are topologically protected whirling spin textures, are viewed as important potential candidates for future data storage devices [1]. In order to integrate the skyrmionic systems in spintronic devices, electrical detection of the skyrmions is necessary [2]. A complete understanding of the electrical behaviour of charge carriers in skyrmion phase requires a detailed investigation of how the dynamics of charge carriers evolve in the skyrmionic phase [3]. In this work, we carried out electrical fluctuation (noise) studies in the skyrmion phase of Pt|Co|Al|Pt based ultra thin film multilayer samples [4]. Magnetic force microscopy (MFM) measurements in presence of external magnetic field of these samples show skyrmion phases in the range of ~ 70 -150 mT. See Fig.1. for a representative MFM image taken at 95 mT. Below 70 mT, the local magnetization is characterized by worm-like features. Low-frequency resistance fluctuation measurements show an increase of fluctuations in the skyrmion phase. Also an increased fluctuation is observed at the transition region from worm-like phase to skyrmion phase. The data allows us to throw light on the low-frequency dynamics of carriers in the skyrmionic phase. A clear indication of relatively slower dynamics of charge carriers in the skyrmion phase is observed.

References

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Figures

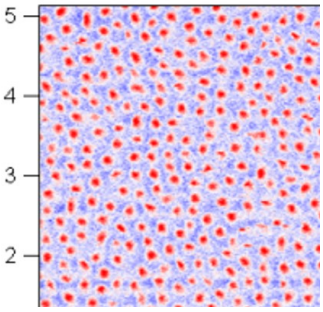

Figure 1: Representative room temperature magnetic force microscopy image of area 5 × 5 μm² taken at external field of 95 mT.

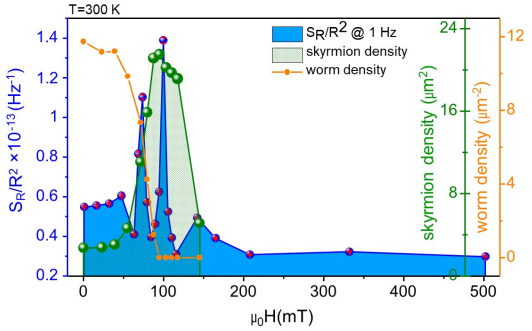

Figure 2: Normalized noise power spectral density (S_R/R^2) and skyrmion/worm density as a function of external magnetic field