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Magnetic and structural properties of half-metallic \( \text{Sr}_2\text{FeMoO}_6 \) epitaxial films fabricated by ultra-high vacuum sputtering

ADAM HAUSER, R.A. RICCIARDO, A. GENC, R.E. WILLIAMS, P.M. WOODWARD, H.L. FRASER, F.Y. YANG, The Ohio State University — \( \text{Sr}_2\text{FeMoO}_6 \), a double-perovskite half-metallic ferromagnet, has attracted much attention because of its high \( T_c \) of 420 K. However, the fabrication of \( \text{Sr}_2\text{FeMoO}_6 \) epitaxial films has been challenging due to impurity phases and disorder. Using ultrahigh vacuum off-axis RF sputtering with precisely controlled low-concentration \( \text{H}_2 \) in \( \text{Ar} \), we have fabricated phase-pure \( \text{Sr}_2\text{FeMoO}_6 \) epitaxial films on \( \text{SrTiO}_3 \) (001) and (111) substrates. X-ray diffraction confirms pure phase with double perovskite ordering. The phase purity and magnetic moments are highly sensitive to the \( \text{H}_2 \) partial pressure. The optimal range for the \( \text{H}_2 \) concentration is 0.4% to 0.6% in \( \text{Ar} \) with 70 mTorr total pressure. The saturation magnetization of the \( \text{Sr}_2\text{FeMoO}_6 \) films grown in this range is 1.5 \( \mu_B \) per formula unit at 5 K, which is a strong magnetization considering the epitaxial strain. Aberration-corrected HAADF TEM images reveal atomically sharp interface between \( \text{Sr}_2\text{FeMoO}_6 \) and \( \text{SrTiO}_3 \).

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