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SPIN POLARIZED CHALCOGENIDE THIN FILMS OF CuCr_2Se_4

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In this work, we demonstrate the successful synthesis of CuCr_2Se_4 thin films. Bulk CuCr_2Se_4 is a highly spin polarized material with a Curie temperature of 460K [1]. Electronic structure calculations indicate that the magnetic moment is primarily due to the high spin polarized Cr density of states balanced by small contributions from the Cu and Se sites with opposite magnetization. Therefore, given successful growth of CuCr_2Se_4 in magnetic thin film form, it would serve as an ideal electrode material for magnetic tunnel junctions. We have synthesized CuCr_2Se_4 films by pulsed laser deposition and varied deposition temperature, partial pressures, substrates, as well as laser energy density. Depositions from room temperature to 650^oC in a vacuum or selenium atmosphere exhibit magnetism on a variety of substrates, including MgO, MgAl_2O_4 , and LiNbO_3 . Using a superconducting quantum interference device (SQUID) magnetometer, we have determined the magnetization value to be near the bulk value of 5 μ_B per formula unit. Atomic force microscopy reveals a topographically smooth surface with a RMS value of 0.24 nm. The Curie temperature is above 390K, the detection limit of our SQUID. X-ray magnetic circular dichroism and x-ray absorption spectroscopy have been performed on these films showing that they closely resemble those of the bulk CuCr_2Se_4 phase.

[1] F.K. Lotgering. Solid State Commun. 2 (1964) 55.