Contribution ID: **416** Type: **Poster Presentation**

Magnetic behavior of Ar implanted ZnO

Our research is driven by the goal to realize ferromagnetism at room temperature on non-magnetic materials such as semiconductors, among other materials. If realized, semiconductor functionality should coexist with ferromagnetism, ideally above room temperature (practical operating temperatures). In our work, ZnO single crystals implanted with 45 keV ⁴⁰Ar ions up to fluences of 4.5×10¹⁵ ions/cm² were selected as a system of interest. Emission Mössbauer Spectroscopy (eMS) measurements were then carried out on the samples following implantation with ⁵⁷Mn* radioactive ion beams, which decay to the Mössbauer atom ⁵⁷Fe via β⁻ decay. Radioactive ion beams were produced at the ISOLDE facility, at CERN, through a fission reaction induced by 1.4 GeV protons on a UC₂ target, followed by a multi-stage laser ionization and mass separation by pure magnets. Two sets of measurements were carried out: (a) Temperature series measurements on the as-implanted sample and on another Ar implanted ZnO sample following annealing at 400 ⁰C in vacuum for 15 minutes, and (b) Angle dependence measurements on the annealed sample, in the presence of an external magnetic field. Temperature dependence measurements show strong magnetic features in the spectrum, with the magnetic field not dependent on the temperature, thus paramagnetism instead of ferromagnetism. Paramagnetism is further confirmed by the angle dependence of magnetic sextet lines in each spectrum. A comparison and discussion of results obtained will be presented.

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Session Classification: Poster Session

Track Classification: Track A - Physics of Condensed Matter and Materials