Magnetic Interfaces and Nanostructures
Room Central Exhibit Hall - Session MI-ThP

Magnetic Interfaces and Nanostructures Poster Session

MI-ThP-1 Molecular Beam Epitaxy of Antiferromagnetic Kagome Alloy CrSn on LaAlO3 (111), ***Tyler Erickson,*** Ohio University*; S. Upadhyay,* Oak Ridge National Laboratory, USA*; H. Hall, A. Shrestha, A. Abbas,* Ohio University*; S. Rajasabai,* Vellore Institute of Technology, India*; D. Ingram, S. Kaya,* Ohio University*; U. Kumar,* Vellore Institute of Technology, India*; A. Smith,* Ohio University*; D. Russell, F. Yang,* Ohio State University

Antiferromagnetic Kagome materials with topologically non-trivial electronic structure provide hosts for exotic magnetic phenomena that is useful for spintronic devices [1-3]. The localization of spin states within the Kagome layers provides opportunities for creating quantum spin-liquid ground states [1], and the capability of tuning the Berry curvature near the Weyl points, thereby engineering moment orientations which could lead to large anomalous Hall effects [2], give these materials a bright future in spintronic devices.At present, we are exploring the possibility of CrSn as a future candidate. Rajasabaiet al.recently published introductory work suggesting an antiferromagnetic Kagome crystal structure for CrSn with spin orientations aligned coplanar and anti-aligned between planes [3]. We have attempted to grow this CrSn alloy using molecular beam epitaxy and to compare it to the expected structure predicted by theory. We have grown multiple CrSn samples and investigated their crystallographic structures and magnetic properties through reflection high-energy electron diffraction, x-ray diffraction, atomic force microscopy,and superconducting quantum interference devicemeasurements. Our RHEED measurements give an in-planelattice parameter of 5.33 ± 0.17 Å while XRD measurements give an out-of-plane dspacing of 2.19 ± 0.02 Å and thereforean out-of-planelattice parameter of 4.38 ± 0.02 Å. These lattice parameters are in good agreement with the predicted lattice parameters. Furthermore, SQUID measurements confirm the lack of ferromagnetism and suggest possible antiferromagnetism.

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[1]S. Li,Y. Cui, Z. Zeng,et al.,Phys. Rev. B109, 104403 (2024).

[2]L. Song et al.,Advanced Functional Materials 2316588 (2024).

[3]S. Rajasabai and U. Koppolu,Journalof Superconductivity and Novel Magnetism 35, 839 (2022).

MI-ThP-2 Magneto-Optical Spectroscopy of Co-Doped ZnO Thin Films Grown by Pulsed Laser Deposition, ***Da-Ren Liu,*** Taiwan Instrument Research Institute, Taiwan

$Zn_{1-x}Co_xO$ is one of the most promising diluted magnetic semiconductors (DMS) materials due to its predicted above room temperature ferromagnetism. In this study, the $Zn_{1-x}Co_xO$ (0.01 < x < 0.10) coatings were grown by Nd:YAG pulsed laser deposition(PLD). The thickness and roughness of the films were characterized by grazing-incidence x-ray reflectivity (GIXR). According to the results of high-resolution x-ray diffraction, the $Zn_{1-x}Co_xO$ thin films are polycrystalline with a preferential growth direction of (002). Atomic force microscopy (AFM) and magnetic force microscopy (MFM) were employed to characterize the surface properties of these films.Photoluminescence spectra demonstrate ultraviolet emission peaks which have shifted with the increase of Co ion concentration. The magneto-optical properties were measured in the range from 1.24 to 3.09 eV by micro-MOKE hyperspectrometer. The results show the room temperature ferromagnetism of the $Zn_{1-x}Co_xO$ thin films suggested that the possibility for the application to diluted magnetic semiconductors.

MI-ThP-3 Interactions of Extended Magnetic Defects in Semimetallic Systems, ***Samuel Tkacik***, *E. Thareja, J. Gayles,* University of South Florida

Topological semimetals offer a unique opportunity to produce controllable magnetic states and intrinsic spin currents that are robust against backscattering from most types of disorder or defects. This is due to nominal protection offered by the topology of their electronic structure. In this work we study extended magnetic defects in models of semi-metallic structures and examine interactions that arise from the magnetic and electrostatic potentials that characterize these defects. We use scattering theory with a conserved current to study the interactions between extended defects and the bulk with parameters motivated from first-principle calculations of Dirac semimetals. We show that two different regimes exist for a finite and discrete model depending on whether the lattice width is odd or even. We study similarities and differences between bound states in both regimes. Our modelled system is expansive in that it uses parameters derived by first-principle calculations and therefore directly motivates experimental studies in such topological systems. Furthermore, our modelled system serves as a fundamental framework for novel devices with magnetic defects.

MI-ThP-4 Growth and Spectroscopy of Altermagnetic MnTe, ***Marco Dittmar***, *H. Haberkamm, P. Kagerer, M. Ünzelmann, F. Reinert,* University of Würzburg, Germany

As a new type of fundamental magnetic order next to ferromagnetism and antiferromagnetism, altermagnetism has recently attracted great attention. It is characterized by antiferromagnetic spin alignment combined with rotational lattice symmetry, which is reflected in a spin-split band structure with spin polarized electronic states.
One of the "workhorse" materials potentially exhibiting this type of magnetic order is MnTe in its hexagonal NiAs-type crystal structure. Here, we investigate MnTe thin films grown on different substrates by molecular beam epitaxy. Using structural characterization methods, we discuss the influence of the growth parameters on the observed films. The electronic structure is assessed by soft X-ray angle-resolved photoemission spectroscopy and shows good agreement with band structure calculations.
[1] L. Šmejkal et al., Phys. Rev. X 12, 031042 (2022)

Author Index

Bold page numbers indicate presenter