Title: Materials and magnetic studies of Sr(CoxTi1-x)O3 deposited on Si(001) for spintronic applications

Type: Student

Awardee: Tiffany Kaspar

Mentors: Scott Chambers – PNNL, Kannan Krishnan – UW

Description: Room temperature ferromagnetism in dilute magnetic semiconductors (DMSs) is highly desirable for practical spintronic devices. The observation of room temperature ferromagnetic behavior in doped wide bandgap semiconducting oxides such as Co-doped ZnO, Mn-doped ZnO, and Co-doped anatase and rutile TiO2 have raised the possibility of DMS behavior in other oxide systems. It is necessary to integrate spintronic materials with technologically relevant semiconductors such as Si. Due to the stability of epitaxial STO deposited by molecular beam epitaxy (MBE) on Si, STO is a prime candidate as a DMS host lattice. Recently, Zhao *et al*.1 found Co-doped La0.5Sr0.5TiO3 deposited on LaAlO3 to exhibit ferromagnetic behavior at room temperature. Work by Chambers *et al.* has found promising results for Co-doped STO deposited on STO(001) substrates. Stoichiometric Sr(Co0.03Ti0.97)O3 exhibited a magnetic moment of 1.1 μB/Co, a coercive field of approximately 150 G, and 18% remanence. In this study, the integration of Co-doped STO onto Si substrates will be explored. Thin film deposition will be accomplished at PNNL by MBE, with the capability of utilizing either molecular or plasma-excited oxygen as the oxidant. Film characterization techniques at PNNL which will be utilized include *in situ* xray photoelectron spectroscopy (XPS) for film composition, atomic force microscopy (AFM) and transmission electron microscopy (TEM) for film morphology, and Rutherford backscattering (RBS) and proton-induced x-ray emission (PIXE) for accurate determination of the Co content. Additionally, samples will be sent to the Advanced Photon Source (APS) at Argonne National Laboratory for Co K-shell x-ray absorption near edge structure (XANES) to determine the charge state of Co. Magnetic properties will be investigated by a combination of vibrating sample magnetometry (VSM) available at PNNL, and superconducting quantum interference device (SQUID) measurements available at UW.