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Towards Design and Control of Magnetic and Electronic Properties of Materials

Abstract

Many research efforts, particularly in the fields of spintronics and microelectronics, are directed towards developing methods to modify or realize new materials properties. Some effective tools for doing this include thin film growth and nanostructuring, disorder and application of electric fields; I will highlight examples of these from my own work during this talk. First, I will show that application of an electric field through a liquid electrolyte gate produces significant, non-volatile and reversible modifications in the electronic structure of transition metal oxides. More specifically, I will explain the origin of the low temperature metallicity in VO2 and WO3 thin films after liquid electrolyte gating using measurements that directly probe the electronic structure of the material. The second part of my talk will focus on tuning the magnetic properties of materials. I will first show how structural disorder was used to enhance the magnetic moment (both spin and orbital components) and spin polarization in amorphous FexSi1-x thin films, a material that is potentially relevant as a spin injector. Finally, I will show that thin films and nanodots of Mn-Ga can be fabricated with perpendicular magnetic anisotropy, suggesting potential in spin transfer torque devices.

Short Bio

Julie Karel earned her Bachelor of Science in Materials Science and Engineering from the University of Wisconsin-Madison (Madison, Wisconsin, USA) in 2005. She worked as a Materials Engineer for Intel Corporation for two years before continuing her studies. Julie holds a Master of Science (2010) and a PhD (2012), both in Materials Science and Engineering from the University of California-Berkeley (Berkeley, California, USA). She carried out her postdoctoral work at the Max Planck Institute for Chemical Physics of Solids (Dresden, Germany) with Prof. Claudia Felser from 2012-2016. Julie currently holds a tenure-track position in the Materials Science and Engineering Department at Monash University located in Melbourne, Australia. Her research interests include utilising either thin film growth techniques or application of external electric fields to control the magnetic or electronic properties of advanced functional materials.