**Materials Seminar**

Department of Materials Science & Engineering

# Monday February 26, 2018

2:00 – 3:00 ~ 500 JDT

Faculty Candidate

"Ionic Control of Materials Beyond Interfaces"

**Speaker: Dr. Dustin Gilbert, Physicist**   
National Institute of Standards & Technology



Gaithersburg, MD

Abstract:

Control of materials through custom design of ionic distributions is one of the most promising approaches for future nanotechnology devices. This technique offers the opportunity to control virtually every property of a material, ranging from electrical and thermal resistivity to optical, mechanical, and magnetic properties, or even superconductivity.[1-5] Ionic devices have the additional benefits of nonvolitility and can be ultra-low power. Control of bulk and quasi-bulk ionic distributions is of particular interest to us, as some material properties are most useful, or even require, lengthscales larger than what is typically considered interfacial. In this talk, I will present our works controlling ionic distributions and consequentially material properties within metal-oxide and metallic thin films. First I will discuss our recent investigations into control of magnetism, resistivity, structure and superconductivity in magnetic heterostructures of (Ni,Co)O/GdFe,[6] perovskites (La,Sr)(Co,Mn)O3,[7,8] and perovskite-like YBa2Cu3O7.[9] In these works we use a solid-state redox-approach to leach oxygen from our films, thus continuously controlling our materials. I will show that perovskites present particular promise for ionic technologies due to their high ion mobility and sensitivity to chemical stoichiometry.[7-9] In the second part of the talk I will discuss our work designing magnetism in Co thin-films with electric fields moderated ionic migration.[3] Our work demonstrates critical limits and identifies details crucial to control of magnetism in metallic systems particularly in the quasi-bulk lengthscale. Electric field control of ionic distributions offers the opportunity to realize new low-power electronics predicated on the control of any of these material properties, including spintronics. These works together show that control of ionic distributions is achievable even beyond the interface limit and that they presents fantastic opportunities for next generation technologies.

Biography:

Dustin Gilbert is a physicist at the National Institute of Standards and Technology (NIST), working at the NIST Center for Neutron Research. He received his B.S. from the University of California at Santa Cruz in Physics, and Ph.D. from the University of California at Davis, also in Physics. He has been active in the area of nanoscale materials with an emphasis on magnetism, including high-anisotropy materials, patterned nanostructures, chiral spin textures, ionic materials, and interface coupled composites. His current research has leveraged the unique capabilities of neutron scattering and synchrotron X-rays together to advance the understanding of new emergent fields, including magneto-ionics, skyrmions, and topological insulators.

This Seminar will be followed by Dr. Gilbert’s vision for future research in MSE 3-3:30. ***Please join us for refreshments at 3:30***

References

[1] U. Bauer, L. Yao, et al., Nat. Mater. 14, 174 (2015).

[2] C. Bi, Y. Liu, et al., Phys. Rev. Lett. 113, 267202 (2014).

[3] D. A. Gilbert, A. J. Grutter, et al., Nat. Commun. 7, 12264 (2016).

[4] J. J. Yang, D. B. Strukov, et al., Nat. Nanotechnol. 8, 13 (2013).

[5] N. Lu, P. Zhang, et al., Nature 546, 124 (2017).

[6] D. A. Gilbert, J. Olamit, et al., Nat. Commun. 7, 11050 (2016).

[7] D. A. Gilbert, A. J. Grutter, et al., Under Review (2018).

[8] A. J. Grutter, D. A. Gilbert, et al., Appl. Phys. Lett. 108, 082405 (2016).

[9] P. D. Murray, D. A. Gilbert, et al., (2018).