DEPARTMENT OF
Chemistry
UNIVERSITY OF WISCONSIN–MADISON

Ph.D. Dissertation Defense

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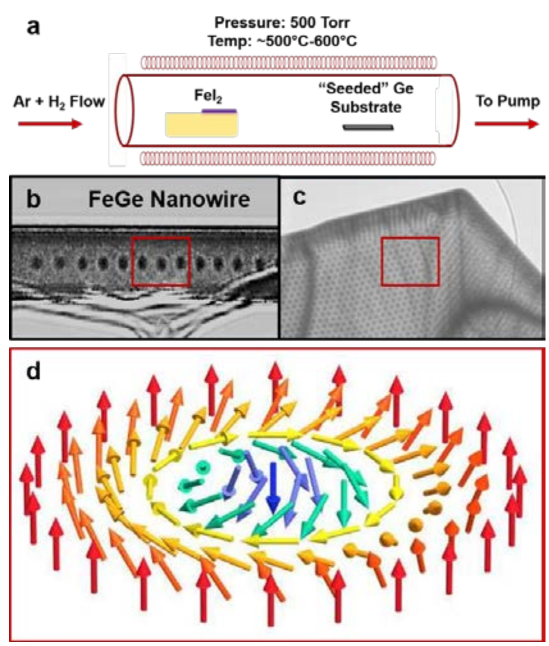
"Observation and Electrical Detection of Magnetic Skyrmions in Iron Germanide Nanostructures"

Magnetic skyrmions are electron spin structures with a non-trivial topology discovered in 2009. In a typical skyrmion, like the one shown in Figure d, hundreds or thousands (depending on the size of the skyrmion) of neighboring electron spins align their magnetic moments in vortex like fashion to produce the magnetic domain. Due to their small size and weak pinning to the underlying atomic lattice, magnetic skyrmions are promising bit carriers for next generation information storage. However, these special spin structures primarily exist in materials that lack inversion symmetry such as the cubic B20 compounds like MnSi and FeGe. Geometrical confinement of these exotic magnetic domains has been shown to greatly stabilize the magnetic skyrmions relative to temperature and applied magnetic field. The bulk of my thesis work has revolved around the observation and electrical detection of these stabilized magnetic skyrmions in FeGe nanostructures grown via chemical vapor deposition (CVD). I first developed "seeded" CVD methods (outlined in Figure a) to grow both FeGe nanowires (Figure b) and $Fe_{1-x}Co_xGe$ nanoplates (Figure c). After the successful growth of these nanostructures, I worked with collaborators to image the different magnetic phases present using Lorentz-transmission electron microscopy. In the magnetic imaging, the skyrmions look like small circular domains emphasized by a red box in Figures b and c. I then used these magnetic contrast images to guide and corroborate the electrical detection of the skyrmion phase in individual nanowire and nanoplate devices.



Monday, June 11, 2018 at 2:00 pm. in Room 9341