UCLA College | Physical Sciences
Chemistry & Biochemistry

## *Chem 218: Student Exit Seminar*

# Understanding the Effect of Composition and Nanostructure on Magnetic and Magnetoelectric Materials


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Abstract: The efficient control of magnetism at small scales is becoming increasingly important in the miniaturization and development of new technologies. However, conventional methods for this control become less efficient at smaller scales. Multiferroic composites are systems in which magnetization can be varied with electric field without the flow of current. This allows for more efficient existing devices, and opens up new types of technologies not possible without multiferroics. I will first discuss the development of new materials for the magnetostrictive component of these composites, optimizing for use in a multiferroic antenna. Using sol-gel chemistry, we explore how material composition and film quality can affect the magnetic properties of yttrium iron garnet based materials, with a goal of reducing high frequency losses and increasing magnetostriction. We look at how doping heavier transition metal and lanthanide ions into yttrium iron garnet affects the static and dynamic magnetic properties using magnetometry and ferromagnetic resonance. Second, I will investigate how the nanoscale structure of the multiferroic composite affects the magnetoelectric coupling. Here, we synthesize a mesoporous cobalt ferrite matrix, the magnetostrictive component, the surface of which is then conformally coated with a piezoelectric via atomic layer deposition. We then control the amount of residual porosity of the composite by varying the thickness of piezoelectric deposited. We find that the amount of magnetoelectric coupling is enhanced with larger residual porosities, with this porosity allowing for larger strains. We also see that the changing the ferroelectric material can greatly enhance this coupling. In summary, understanding how composition and structure affect the properties of these composites is crucially important when designing new multiferroic devices.


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