Physics Colloquium
Graduate Posters
Michigan Technological University
Thursday, April 17. 2014
1:00 – 3:00 pm
Aftermath Atrium in Fisher Hall

Investigation of the Resistance to Demagnetization in Bulk Rare-Earth Magnets Comprised of Magnetically-Isolated, Crystallographically-Aligned, Single-Domain Crystallites
Jie Li
Advisor: Dr. Peter Moran

Abstract: The goal is to determine whether specific microstructural modifications to Neodymium-Iron-Boron ($Nd_2Fe_{14}B$) bulk magnets can result in the increased resistance to demagnetization (coercivity), which is now only obtainable by substituting ~10wt% dysprosium (Dy) for some of the neodymium (Nd) in $Nd_2Fe_{14}B$ magnets. The approach is to reduce the size of individual crystallographically-aligned grains in the magnet so that each grain can only support a single magnetic domain and to simultaneously dilute the Nd-Fe inter-granular phase present in conventional magnets with a non-Fe-containing Nd-rich phase such as Nd-Cu, Nd-Ag or Nd-Al to magnetically isolate the individual crystallites. A developed hot deformation process, which can produce bulk magnets with crystallographically-aligned submicron crystallites by means of a selective dissolution and re-precipitation mechanism, is proposed to result in a bulk magnet with the microstructural features described above.

Effective Extraction of Nanomaterials from Water Contaminated with Nanotubes, Nanowires, Nanosheets, and Nanoparticles
Bishnu Tiwari
Advisors: Dr. Yoke Khin Yap and Dr. Dongyan Zhang

Abstract: Because of the extraordinary properties of the nanomaterials, research activities and applications of nanomaterials have continued to increase. However, the impacts of nanomaterials to the environment (air, water, plants, and living organisms) have not being carefully evaluated. This means, the possibility that water becomes contaminated with various nanomaterials will be increased due to the increase use of nanomaterials. Here we demonstrate a simple and quick technique to clean such contaminated water with almost 100% efficiency.

Laboratory Measurements of Contact Freezing by Dust and Bacteria at Temperatures of Mixed Phase Clouds
Joseph Niehaus
Advisor: Dr. Will Cantrell

Abstract: Contact nucleation of ice is thought to play a significant role in the atmosphere where the freezing of water droplets remains one of the biggest uncertainties in current models of the atmosphere. Contact freezing efficiencies for various atmospherically relevant aerosols are reported for the temperature range 0 to -20 °C. The results are discussed in the context of mixed phase clouds, and we find that dry, micron sized dust aerosols can have substantive impact on warm temperature nucleation. Bacteria has the potential to be even more effective. Samples of Pseudomonas syringae and Pseudomonas fluorescens had widely varying freezing behavior. Nucleation threshholds cannot be easily predicted by the gene markers ice-positive or ice-negative as was done in past years for immersion freezing. In all cases the contact mode dominates the immersion mode freezing.

For Arizona Test Dust, feldspar, and rhyolitic ash, more than 1e3 particles sized between 0.3um - 10.0um are required to initiate a freezing event at -20 °C in the contact mode. An ice negative strain of P. fluorescens is an order of magnitude more effective than the mineral dusts at every temperature tested. We find that an ice positive strain of P. syringae reaches its maximum nucleating efficiency of 0.1 twelve degrees earlier than does the P. fluorescens, similar to the behavior of ice negative and positive bacteria in the immersion mode, as discovered 40 years ago [Maki et al., 1974; Vali et al., 1976]. Surprisingly, cells of the ice positive strain (CC94) P. syringae which did not express the ice+ gene, showed no contact freezing activity, whereas the ice- strain of P. fluorescens did.

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