Physics Colloquium (Continued)
Graduate Posters
Michigan Technological University
Thursday, April 18. 2013
1:00 – 3:00 pm
Aftermath Atrium in Fisher Hall

Implementation of a Hot-Deformation Process for Making $Nd_2Fe_{14}B$-based Permanent Magnetic Materials

Jie Li
Advisor: Dr. Peter Moran

Abstract: Grain size plays an important role in the demagnetization behavior of nanocrystalline exchange-coupled magnets. Hot deformation is a thermo-mechanical process used to produce fully dense textured nanostructured magnets from melt-spun ribbons. A hot deformation process of making $Nd_2Fe_{14}B$-based permanent magnetic materials with single domains is implemented in this project. Strong crystallographic texture with c-axis of $Nd_2Fe_{14}B$ crystallite parallel to press direction is observed. High coercivity force (23.4 kOe) can be achieved on magnets with 5.5 wt% Dy. The magnetic properties of magnets can be enhanced by proper post heat treatment.

Experiments in Contact Nucleation:

Joseph Niehaus
Advisor: Dr. Will Cantrell

Abstract: The phenomenon of ice nucleation in the atmosphere remains a mystery as scientists are still working to describe precipitation and cloud microphysics. We focus on the interactions of aerosols and supercooled liquid water. Aerosols at the surface of a cloud drop have been found to form ice more easily than those inside the droplet. We investigate the effects of different bacteria, pseudomonas syringae and pseudomonas fluorescens, acting in both the contact and immersion mode. We find that the contact mode is nearly 100x more efficient for the same bacteria, which could have significant impacts on cloud glaciation and radiative properties.

Broadband Measurement of Black Carbon Absorption and Scattering Coefficients Using a Supercontinuum

Integrated Photoacoustic and Nephelometer Instrument

Noopur Sharma
Advisor: Dr. Claudio Mazzoleni

Abstract: Optical properties (absorption and scattering) of atmospheric aerosols are necessary for predicting climate. These properties are affected by complicated atmospheric processes like mixing and aging. Optical properties vary with aerosol composition and exhibit unique wavelength dependencies. At Michigan Technological University in collaboration with the Desert Research Institute, we are developing a new integrated photoacoustic-nephelometer spectrometer that uses a supercontinuum (SC-PNS) laser as light source to characterize the aerosol optical properties over almost the entire solar spectrum. We will present the design of the prototype instrument, its performance and initial tests with kerosene soot and common salt.

Synthesis, Characterization, and Transferring of Graphene Sheets

Bishnu Tiwari
Advisor: Dr. Yoke Khin Yap

Abstract: Graphene is monolayer graphite with hexagonal carbon network in one atomic thickness. Single layer Graphene (SLG) offers high electron mobility, high optical transparency (98.7%), and extraordinary mechanical strength for application in high frequency switches, solar cells, sensors, and Li-ion batteries, etc.. Copper (Cu) substrate could be used for the synthesis of SLG by chemical vapor deposition (CVD) at ~1000 ^{o}C. However, this is very close to the melting point of copper (1085 ^{o}C), limiting CVD growth at higher temperatures for high-quality Graphene with large grain sizes. On the other hand, Nickel (Ni) has much higher melting point (1455 ^{o}C), but often lead to the growth of multilayer Graphene (MLG). Here we propose an alternative procedure to produce SLG on Ni substrates. Preliminary data will be discussed in the poster.

Three Dimensional Shape and Surface Roughness of Mineral Dust using Atomic Force Microscopy

XIN XIN WOODWARD
Advisor: Dr. Will Cantrell

Abstract: Mineral dust in the atmosphere plays a role in Earth's climate through its ability to absorb and scatter radiation (both solar and terrestrial) and through its part in the hydrological cycle as cloud condensation and ice nuclei. The three dimensional characteristics of dust are particularly important for their part in Earth's radiative balance and, perhaps, for their role as ice nuclei. As examples, the optical properties of mineral clay aerosol are best fit by assuming that they are highly eccentric oblate spheroids (Meland et al., 2012) and the surface roughness of dust may determine their efficacy as ice nuclei (Hoose and Mohler, 2012).

Most sizing methods capture one or two dimensions for particles. In contrast to differential mobility analyzers, scanning electron microscopes and other devices, atomic force microscopes acquire information in three dimensions. We have investigated individual aerosol particles of both Arizona Test Dust and kaolinite and find that the asphericity is quite pronounced. Also they both have their own general shapes. The height of most particles is typically a factor of five to ten smaller than the average dimension in the projected area. We will present analysis of detailed, three dimensional images of both Arizona Test dust and kaolinite along with Polya numbers to understand the roughness of particles. In particular, we will show the asphericity for the dusts as well as discuss the surface roughness for each.

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