PHYSICS

Section Moderator: Dr. Robert Magruder
Room: Hitch Science Building 202
Time: 7:00 – 8:20 PM

7:00 – 7:20
"Optical Properties of Ag nanoparticles formed by Ion Implantation in Sc modified Silica"

Caitlin V. Smith
Faculty Advisor: Dr. Robert H. Magruder III

Glass with metal nanocrystals exhibits unique characteristics. In these experiments, Sc-O modified silica with Ag nanocrystals were examined. Three samples were made by first implanting Sc at 160 KeV at concentrations of 7.5, 12.5 and 22.5×10^{16} ions/cm^2. Then, the samples were implanted with O at 65 KeV. The samples were then annealed at 900 °C. Finally the silica samples were implanted with Ag at a concentration of 6×10^{16} ions/cm^2 at 305 KeV. The microstructure of the nanoparticles in the samples was distinguished by transmission electron microscopy (TEM) using a JOEL 2010 TEM. Optical reflectance spectra were taken from 300 to 800 nm at 12° using a Cary 5 UV-VIS spectrometer with a Harrick Model ERA-12G reflectance attachment. The data was normalized using a silver mirror. Samples were analyzed on both the implanted and non-implanted faces.

On all three samples, the reflectances on the implanted faces had peaks at ~370 and ~490 nm. The spectrum of the 7.5×10^{16} ions/cm2 Sc non-implanted faces has peaks at 395 and 489 nm. The non-implanted face of the 12.5×10^{16} ions/cm^2 Sc has a peak at 420 nm and a slight shoulder at ~478 nm. Lastly, the 22.5×10^{16} ions/cm^2 Sc non-implanted face has a peak at 404 nm. As the implanted concentration of Sc increased, the second peak on the non-implanted face decreased to a shoulder then became non-existent. On the implanted face, while the peaks remained at around the same wavelength, the reflectance of the first peak decreased with increasing concentration of Sc and the reflectance of the second peak increased with increasing concentration of Sc.

7:20 – 7:40
"COMSOL Modeling: Pulsed Laser Annealing of Magnetic Thin Films"

Caleb Swartz, J.W. Harrell, Yuki Inaba, Iulica Zana
Faculty Advisor: Dr. Robert Magruder

This research focuses on magnetic thin films performed at the University of Alabama's Materials for Information Technology (MINT) center. The magnetic thin films in question are intended for use in computer hardware in an effort to increase the storage capacity of typical models of hard drives. Pt and FePt films were examined as alternatives to current materials due to their face-centered cubic structure which is more magnetically stable at a smaller grain size.

Motivating the Pt and FePt films into this ordered A_1 phase requires thermal annealing. In this case, the annealing was performed with laser pulses in the milli-second range to avoid the grain growth problems often associated with more gradual methods of annealing. The difficulty surrounding the collection of accurate data when using pulsed laser annealing required simulation of the annealing using the physics software known as COMSOL—a method which Swartz examines extensively.

The simulations were manipulated and data collected for a variety of pulsed laser simulations. Heat diffusion, and the effects on temperature over time were measured, using various pulse times, as well as a number of film configurations. Thermal constants such as thermal conductivity and heat capacity, as well as the dependence of these properties upon temperature was also simulated, and the results demonstrated for both glass and silicon substrates.

7:40 – 8:00
"FFTs and Digital Signal Processing"

Tyler Welton
Faculty Advisor: Dr. Scott H. Hawley

Using the concepts of Fast Fourier Transforms and their application in digital signal processing to affect the frequency and phase of signals, specifically audio. This was done with the use of aC/C++ programming environment.

8:00 – 8:20
"Asteroid Orbit Determination and Photometry"

Kayla LaFrance, Engineering Physics
Faculty Advisor: Christian Thomas

To determine the orbital length and path of an asteroid I observed the asteroid over several nights and recorded it locations in the sky. The collected data was used along with an orbital determination program that I created. Together I could take the observed positions and use them to estimate the path of the asteroid around the sun. The goal of asteroid photometry is to determine the physical properties of asteroids such as their size, shape, rotation, and orbital period by studying their light curves - a graph of light intensity of a celestial object or region, as a function of time. Fitting software for light curves can be used to gather information about the sine and inverse sine of the graph, which then mathematically can be used in finding out further information on the asteroid.