after various numbers of sputtering and annealing cycles, we systematically studied the formation of these defects as a function of the Ar ion sputtering energy. Although the number and size of pyramids increased with sputtering energy from 100 to 200 eV, the sample sputtered with 300 eV ions showed a very flat surface with very few pyramids. The sample sputtered with 400 eV ions appears to have mountain ranges of highly stepped regions with numerous pyramids on the edges, separated by flat valleys of reconstructed (8x10) surface. Many pyramids are capped by a cluster of atoms, probably carbon, which may have served as the nucleation site. To explain the dependence of defect formation on sputtering energy, we present a mechanism involving competition between uncovering parts of new pyramids and breaking down older pyramids. Using different sputtering energies for controlled defect formation could be an effective tool for controlling island growth at defects on substrates.

Undergraduate Student

8:12 AM A46.00002 Inverted Pyramid Texturing of Si by Single Exposure Three-beam Interference Lithography, B. SUMMERS, M. LANGHOF, K. GHOSH, Missouri State University — Increasing energy demands combined with environmental concerns prompts the need for cost-efficient solar cells. One way in which this can be achieved is by etching an inverted nano-pyramid texture into the silicon substrate thereby reducing the requisite amount of material. This is due to the ability of altering the pyramid size such that it corresponds to specific wavelengths, which results in higher light trapping efficiency. These inverted pyramids can be fabricated using three-beam lithography to create the desired hole/dot photorefrist pattern in order to etch the substrate. The process can be done as a single exposure by aligning two dielectric mirrors and the sample at specific angles with respect to one another and the incoming laser beam. Using this method, nanostructures of Si and wide bandgap oxide semiconductors such as ZnO and NiO will be fabricated. Detailed results will be discussed in this presentation. This work is partially supported by National Science Foundation (DMR-0907037).

8:24 AM A46.00003 Effects of Sputtering Energy on Surface Defect Formation on Ge(110)1, SAMANTHA MACINTYRE2, MARSHALL VAN ZULL, BRET STENGER, MICHAEL NORTON, NOELLE OGURI, SHIRLEY CHIANG, University of California Davis — Pyramid-shaped defects were observed in STM images to form on clean Ge(110) surfaces as a result of argon ion sputtering. By periodically imaging the samples after various numbers of sputtering and annealing cycles, we systematically studied the formation of these defects as a function of the Ar ion sputtering energy. The T1 spin lifetime, the time required for initially polarized electrons to relax and randomize. Using a circularly polarized laser tuned to the wavelength response of the quantum dot we can “pump” the spins into alignment. After aligning the spins we can detect them using a second, linearly polarized “probe” laser. By changing the delay between the two lasers we can trace out the spin response over time. In contrast with other samples (bulk GaAs and a GaAs quantum well), where the spin response decayed exponentially with time, initial data on the quantum dots has shown an unexpected, oscillating behavior which dies out on the order of 700 ns, independent of both temperature and magnetic field.

8:36 AM A46.00004 Studies of electron spin in GaAs quantum dots, DANIEL CRAFT, JOHN COLTON, TYLER PARK, PHIL WHITE, Brigham Young University — We have studied electron spins in GaAs quantum dots with a pump-probe technique that normally yields the T1 spin lifetime, the time required for initially polarized electrons to relax and randomize. Using a circularly polarized laser tuned to the wavelength response of the quantum dot we can “pump” the spins into alignment. After aligning the spins we can detect them using a second, linearly polarized “probe” laser. By changing the delay between the two lasers we can trace out the spin response over time. In contrast with other samples (bulk GaAs and a GaAs quantum well), where the spin response decayed exponentially with time, initial data on the quantum dots has shown an unexpected, oscillating behavior which dies out on the order of 700 ns, independent of both temperature and magnetic field.

8:48 AM A46.00005 Surface plasmon enhanced Förster resonance energy transfer in fluorescent molecules using metal wire gratings, ZACH WETZEL, JENNIFER STEELE, Trinity University — Förster resonance energy transfer (FRET) is a powerful tool used to study spatial relationships in biological systems. FRET relies on a nonradiative energy transfer between a donor (D) and acceptor (A) fluorophore. The D-A pair must be located within their Förster radius for an efficient transfer of energy. Surface plasmon (SP) excitations increase the emission of fluorescent molecules by two mechanisms. SPs excited at the fluorophore absorption wavelength increase the excitation rate of the fluorophores. SP modes at the fluorophore emission wavelength provide an additional decay channel for the fluorophores to return to the ground state, increasing the quantum yield and the photostability of the fluorophore. In this study, metal wire gratings were chosen because gratings support SP resonances over a wide wavelength range, allowing overlap for both absorption and emission wavelengths. This research seeks to develop methods for using metal grating SPs to increase the Förster radius for D-A pairs. For this project, gold gratings with a period of 500 nm were fabricated using a nanotransfer printing method. Fluorescence was measured as a function of angle to determine the enhancement. These outcomes will increase the number of physical systems that can utilize FRET.

9:00 AM A46.00006 Remotely Tunable Nonlinear Metamaterial at Microwave Frequency, SHELBY LEE, Marietta College, SINHARA SILVA, JIANFENG ZHOU, University of South Florida — We demonstrate a remotely tuneable metamaterial at microwave frequency. The metamaterial consists of a two-gap split ring resonator with varactor diodes integrated in to one of the gaps. By varying a microwave pump signal remotely, the capacitance of the varactor diodes can be controlled. Thus we can tune the working frequency of the metamaterial. Our metamaterials enable an easily-applicable approach to realize tunable frequency without an external bias circuit compared to other tunable metamaterials.

9:12 AM A46.00007 Determination of the surface spin-polarization of perovskite oxides using point-contact Andreev reflection spectroscopy1,2, EVERETT GRIMLEY, Centenary College of Louisiana, Shreveport, LA 71104, AMLAN BISWAS, Department of Physics, University of Florida, Gainesville, FL 32611 — Materials with surface spin-polarization are invaluable for incorporation into devices that utilize spin-polarized currents. Point-contact Andreev reflection spectroscopy is currently one of the few techniques capable of direct measurement of surface spin-polarization. Niobium wire was electrochemically etched in a potassium hydroxide solution to form sharp tips which were used to form point-contacts with perovskite oxides in single crystal and thin film forms. Surface spin-polarization values were determined at 4.2 K for several materials including La$_2$Sr$_2$MnO$_6$, which is a material with purported 100% spin polarization. The results show that surface spin polarization of perovskites is smaller than theoretically predicted.

1Undergraduate Student

2Funded by NSF CHE-0719504 and NSF PHY-1004848.

3Present Address: Shippensburg University, Shippensburg PA, 17257
9:24AM A46.00008 Spin Propagation Through Antiferromagnetic Bulk Structure in Exchange Biased Magnetic Trilayers, MICHAEL CRUMRINE, Beloit College, HILLARY KIRBY, CASEY MILLER, University of South Florida — When an exchange bias is induced in materials with a ferromagnetic (FM) – antiferromagnetic (AF) interface, the interfacial coupling between the antiferromagnet and FM manifests itself as a shift in the magnetic hysteresis loop. It has been an unresolved issue as to the role the bulk spin of the antiferromagnet plays in exchange bias and whether or not exchange bias is entirely an interfacial effect. We fabricated several FM/AF/FM trilayer structures of Py(100Å)/FeMn(x)/NiCuU31(200Å) with varying antiferromagnet thicknesses and used a field cool procedure to induce an exchange bias. A Magneto-Optical Kerr Effect magnetometer was used to investigate the propagation of spin information through the antiferromagnet by examining the hysteresis loops at different angles of applied field with respect to the magnetization. It was observed that there was no induced exchange bias in the NiCu probe layer for any of the antiferromagnet thicknesses, and we conclude that the patterning of the antiferromagnetic layer transmits no spin information for thicknesses greater than 100Å.

9:36AM A46.00009 Systematic Investigation of Magnetostriction in Composite Magneto- theological Elastomers: the Effect of Particle Shape, Alignment, and Volume Fraction, CHRISTOPHER KASSNER, WILLIAM RIEGER, PARIS VON LOCKETTE, SAMUEL LOFLAND, Rowan University — We have completed a study of the magnetoelastic properties of several types of magnetorheological elastomers (MREs), composites consisting of magnetic particles cured in an elastic matrix. We have made a number of samples with different particle arrangements (pseudo-random and aligned), volume fraction, and particle shape (rods, spheres, and disks) and measured the field dependent strain in order to determine the magnetostriction. We found that the magnetostriction in these samples is highly dependent on the sample particle shape (aspect ratio) and volume fraction and ordering to a lesser extent. While much of the past work has focused on spherical particles, our results indicate that both rods and disks can yield enhanced results. We discuss our findings in terms of magnetic energy of the particles and elastic energy of the matrix. We then consider the issue of optimization. This work was supported in part by NSF Grant CMMI-0927326.

9:48AM A46.00010 Magnetic-Field Dependence of the Spinon Velocity in the $S=1/2$ Linear-Chain Heisenberg Antiferromagnet Copper Pyrazine Dinitrate, K.E. MARINO, Pennsylvania State University, C.P. AYOAMA, University of Florida, M.M. TURNBULL, C.P. LANDEE, Clark University, Y. TAKANO, University of Florida — We have measured the specific heat of fully deuterated copper pyrazine dinitrate (CuPzN), a spin-1/2 antiferromagnetic chain compound, at temperatures down to 0.12 K in magnetic fields up to 14 T. This was done to reduce nuclear heat contributions by using deuterated CuPzN and to better define the magnetic heat capacity by taking measurements beyond the saturation field. The results are in good agreement with previous data taken by Hammar et al. in fields up to 9 T. The spinon velocity obtained from the specific heat is compared to theoretical predictions as a function of magnetic field.

10:00AM A46.00011 ABSTRACT WITHDRAWN

10:12AM A46.00012 Bulk Growth of YBa$_2$Cu$_3$O$_{7-x}$ Superconductors with Enhanced Flux Pinning, JODI-ANN MCLEAN, MATTHEW C. SULLIVAN, JANET HUNTING, Ithaca College — We present our work on the bulk growth of YBa$_2$Cu$_3$O$_{7-x}$ (Y-123) superconductors with enhanced flux pinning abilities grown using the melt textured growth method. Polycrystalline precursor materials of superconducting Y-123 and insulating Y$_2$BaCuO$_2$ (Y-211) are synthesized by sintering commercially available Y$_2$O$_3$, CuO, and BaCO$_3$. This process is repeated multiple times to improve the purity and crystal structure of the precursors. In order to make a superconductor with enhanced flux-pinning, it is necessary to add insulating Y-211 impurities to act as pinning centers to the bulk Y-123 superconductor, heat the mixture to temperatures that liquify the superconducting phase, then cool the mixture slowly to crystallize the superconducting phase. Afterwards we anneal the enhanced flux-pinning superconductor in oxygen to restore oxygen content that was removed during the firing process. We present data on the crystal structure of the precursor materials (Y-123 and Y-211)) and the superconducting transition temperature of the precursor Y-123. In addition, we present data on the transition temperatures and the flux pinning forces of the enhanced flux-pinning superconductors.

10:24AM A46.00013 Growth and Characterization of Na-doped KFeAs, ZACHARY SIMS, GUOTAI TAN, SCOTT CARR, CHENGLIN ZHANG, PENGCHENG DAI, University of Tennessee, Department of Physics, UNIVERSITY OF TENNESSEE, CONDENSED MATTER PHYSICS TEAM — We grew multiple dopings of Na-doped KFeAs, with a goal of observing an upward shift in the Tc from the KFeAs parent compound and a sharpening of the transition phase curve. Using a VSM and PPMS to characterize the magnetic transport, resistivity, and heat capacity, we have come to a conclusion on the success of Na-doping into the KFeAs family of FeAs superconductors.

10:36AM A46.00014 Synthesis and Characterization of Ytterbium-filled CoGe$_{1.5}$Se$_{1.5}$ compositions, WALTER HILL, Department of Engineering, Jacksonville University; Department of Mechanical Engineering, North Carolina Agricultural and Technical State University, YONGKWAN DONC, GEORGE S. NOLAS, Department of Physics, University of South Florida — Polycrystalline skutterudite-related compounds with nominal composition YbCo$_{1.5}$Ge$_{6}$Se$_{6+x}(0 \leq x < 1)$ were prepared by melting of the constituent elements followed by annealing, and subsequent hot-pressing for densification. Structural and phase characterization was achieved by X-ray diffraction and electron microscopy. The crystal structure of skutterudites allows for voids within the crystal lattice that can be filled by “guest atoms” such as ytterbium. It is well known that this guest-atom-filling of the voids can result in significant phonon scattering, although these materials possess relatively good electrical properties, and are therefore thought of as PGEC (Phonon Glass Electron Crystal) materials. The goal of this research was to synthesize these skutterudite-related compounds and examine their thermoelectric properties. Their composition and properties will be discussed.

1University of South Florida Physics REU Program; Novel Materials Laboratory at the University of South Florida; NSF Grant DMR-1004873

10:48AM A46.00015 Designing Drops, Loops, and Hills: The Physics behind Roller Coaster Design, KATHRYN CHRISTIANA, CAROLINA ILIE, Physics Department, State University of New York at Oswego — Almost everyone has seen a roller coaster at one time in their life. They range in type from old wooden coasters from decades passes to modern machines made of steel that allow you to stand up while riding. The basic physics behind these machines is relatively simple, but in the modern world we strive to design bigger and better machines that push the human body and the laws of physics to their limits. But how do the designers of these rides maintain the balance between making riders feel like they’re on the brink of death while keeping them completely safe? The answer can be found in basic physics and mechanical engineering. This is a part of the honors thesis that focuses on the mechanical principles applied in roller coaster design. The theoretical part of the thesis will be complemented by a full small scale ride design.
11:15AM B46.00001 Redesign of an AC Magnetic Susceptometer for Measurements in Smaller Samples1, ANDRES VARGAS, RYAN FUKUDA, SMITHA SUNNY, PEI-CHUN HO, Department of Physics, California State University, Fresno — A new AC magnetic susceptometer was created for the purpose of measuring the magnetic properties of smaller samples, such as nanoparticles that are currently being synthesized in our lab. The susceptometer consists of a primary coil, a secondary coil, and a sample holder. The primary coil is the outer component of the susceptometer, which provides a magnetic field when current is applied due to Ampere's Law. Inside of the primary coil lies the secondary coil, which has two oppositely wound solenoids; they are oppositely wound to reduce background signal. The sample holder lies inside of the secondary coil with the sample. All of these go inside of a beryllium copper casing for protection. We tested the susceptometer by looking for the ferromagnetic phase transition of an 11 mg Gd sample. $A \sim 100\mu A$ AC current was applied to the primary coil, which created a magnetic field that polarized the magnetic moments in the sample. This induced a voltage on the secondary coil, which is proportional to the magnetic susceptibility. We measured the temperature dependency of the induced voltage from 10 K to 300 K. The results showed a sharp increase in the induced voltage around 293K, which agrees with the known ferromagnetic transition of Gd.

1Research at CSU-Fresno is supported by NSF DMR-1104544. Felipe Vargas is also supported by Undergraduate Research Grant and Faculty-Sponsored Student Research Award at CSU Fresno.

11:27AM B46.00002 Electrospun fibers of PLA/P3HT blends for device and sensor applications1, WILLIAM SERRANO, NICHOLAS PINTO, University of Puerto Rico - Humacao — The thermoplastic aliphatic polyester, poly (lactic acid) (PLA) is a biodegradable polymer that is sometimes used in implant screws for bone repair. Our focus was to fabricate fibers of this polymer and its blends with p-doped poly (3-hexylthiophene)-(P3HT) in order to extend its use to devices and/or sensors. PLA/P3HT fibers were prepared in air at room temperature using the electrospinning technique that is cheap, fast and reliable. Scanning Electron Microscope images of the fibers reveal that the presence of P3HT does not affect the fabrication of PLA fibers at low or high polymer concentrations in chloroform, retaining the same morphological structure of pure PLA fibers. The fiber diameters were in the range 1-10 microns. A slight increase in fiber formation results with the addition of P3HT, most likely due to a reduction of the solution surface tension. Results of the electrical characterization of this material will be presented.

1DoD and NSF

11:39AM B46.00003 AC Circuit Measurements with a Differential Hall Element Magnetometer1, MATTHEW W. CALKINS, B. SCOTT NICKS, PEDRO A. QUINTERO, MARK W. MEISEL, Department of Physics, University of Florida — As the biomedical field grows, there is an increasing need to quickly and efficiently characterize more samples at room temperature. An automated magnetometer was commissioned to do these room temperature magnetic characterizations. This magnetometer, which is inspired by a Differential Hall Element Magnetometer, uses two commercially available Hall elements wired in series. One Hall element measures the external magnetic field of a 9 T superconducting magnet and the other measures the same external field plus the field due to the magnetization of the sample that sits on top of the Hall element. The difference between these two Hall elements is taken while a linear stepper motor sweeps through the external magnetic field. The linear motor and data acquisition are controlled by a LabVIEW program. Recently, the system was outfitted for AC circuit measurements and these data will be compared to DC circuit data. In addition, the lowest signal to noise ratio will be found in order to deduce the smallest amount of sample needed to register an accurate coercive field.

1Supported by the NSF via NHMFL REU (DMR-0654118), a single investigator grant (DMR-1202033 to MWM) and by the UF Undergraduate Scholars Program.


11:51AM B46.00004 Low Temperature Probe for Measuring Anisotropic Magnetotransport1, GALIN DRAGIEV, DANIEL GRANT, AMLAN BISWAS, Department of Physics, University of Florida, Gainesville, FL 32611 — Certain materials display a change in resistance when a magnetic field is applied on them. This resistance change is called magnetoresistance (MR). The value of MR may also depend on the direction of the magnetic field relative to the crystal structure of the material, which is called anisotropic MR (AMR). We built a probe which allows us to measure the AMR of a sample in a temperature range of 1.2 K to 300K in magnetic fields of up to 9 tesla. The probe design allows the angle between the magnetic field and a particular direction of the sample to be changed over almost the entire solid angle of 4$\pi$. In particular, this probe lets us measure the AMR of a sample with magnetic anisotropy when the magnetic field is applied either along the hard or easy axes, or somewhere in between. The probe allows us to change the orientation of the sample while it is inside the low temperature cryostat. We will present our data on hole-doped manganese oxide (manganite) thin films and discuss the possible origins of AMR in these materials.

1NSF DMR 0804452

12:03PM B46.00005 Probing Quantum Turbulence in He II with a MEMS Oscillator1, ALEK-SANDER LEVENTAL, BOSH BAUER, MIGUEL GONZALEZ, PAN ZHENG, YOONSEOK LEE, University of Florida, HO BUN CHAN, The Hong Kong University of Science and Technology — Micrometer scale mechanical oscillators based on MEMS technology have been developed for the study of quantum fluids and have been tested successfully at ultra low temperatures. Our recent low temperature test [1] in which the device was immersed in the superfluid phase of $^4$He revealed striking behavior below 400 mK: nonlinear and hysteretic resonance at high excitations. The observed phenomenon is thought to be related to vortices and quantum turbulence and warrants a systematic investigation for better understanding. We constructed an experimental set-up that allows us to cool a MEMS device in liquid $^4$He down to 50 mK at pressures up to 25 bar. We will discuss our new set-up and present our preliminary results performed at saturated vapor pressure.


1This work is supported by NSF through DMR-1205891 (YL).
12:15PM B46.00006 Exploration of Quartz Tuning Forks as Potential Magnetometers for Nanomagnets1, B. SCOTT NICKS, MATTHEW W. CALKINS, PEDRO A. QUINTERO, MARK W. MEISEL, Department of Physics, University of Florida — A change in the resonance frequency, \( f_0 \), of quartz tuning forks is expected when nano-sized magnetic particles or films are applied to a fork that is then exposed to a variable magnetic field. This work explores the feasibility of using these forks, once removed from their protective canisters, as potentially inexpensive magnetometers operating at room temperature in fields up to 2 T, and eventually up to 9 T, by analyzing the responses of loaded forks in such a field. However, the forks are also dependent on subtle variations of the ambient temperature, and the magnetic leads may present a background signal that must be subtracted. Preliminary results are encouraging, but better understanding of the noise sources must be made for these forks to be used as envisioned.

1Supported, in part, by the NSF via DMR-1156737 (UF Physics REU Program) and DMR-1202033 (MWM). We acknowledge early contributions to this work by Philip D. Javernick (UF Physics REU 2011).

12:27PM B46.00007 Toward CN-VFET logic circuits1, STEPHEN GILBERT, BO LIU, MITCHELL MCCARTHY, EVAN DONOHUE, ANDREW RINZLER, University of Florida, Department of Physics — Gate field modulation of the Fermi level in the low density of electronic states carbon nanotubes provides a new control mechanism for modulating the Schottky barrier between the nanotubes and a semiconductor to control charge injection across their interface. This has been exploited in the recently developed carbon nanotube-enabled vertical field effect transistor (CN-VFET) comprised of a bottom gate, dielectric layer, dilute nanotube source electrode, semiconducting channel layer, and drain electrode situated in a collinear, vertical stack. Since the channel length in this architecture is simply the thickness of a thin film, the naturally short channel lengths can overcome the relatively low mobility of organic semiconductors to source higher on-state currents or potentially improve operating speeds. Prototype logic gates using such organic transistors have yet to be demonstrated. As a step in this direction we have fabricated organic CMOS inverters utilizing a p-type and an n-type CN-VFET. The device fabrication, materials used, performance and progress toward a CN-VFET ring oscillator will be discussed.

1We acknowledge support from Nanoholdings LLC. S.G. acknowledges support from the NSF UF Materials Physics REU program.

12:39PM B46.00008 Pressure Dependence of MEMS Oscillator Quality Factor1, JOSHUA BAUER, University of Florida, SARAH GEIGER2, Millersville University, MIGUEL GONZALEZ, PAN ZHENG, YOONSEOK LEE, University of Florida — This paper details a study in which the pressure dependence of the quality factors and resonance frequency of a micro-electro-mechanical device is examined. The results obtained will aid in the understanding of the effects of slide film damping in various gases on oscillators operating at micrometer length scales. The device utilized was a capacitively driven plate oscillator positioned 1.25\( \mu \text{m} \) above a silicon substrate. The dominant damping mechanism for this geometry is slide film damping from the gaseous film between the oscillating plate and substrate. The mechanical resonance of the device was characterized as a function of pressure from 6 mTorr to 1 atm in air. We observed three distinct damping regimes in the quality factor. In addition to the characterization performed in air, pressure dependences in helium and argon were also examined at pressure ranges of 6.5 mTorr to 5 Torr and 750 mTorr to 760 Torr, respectively.

1This work is supported by NSF under DMR-1205891 and DMR-01156737 (SJC).

2Current Address: Millersville University, Millersville, PA 17551, USA

12:51PM B46.00009 Intrinsic Localized Modes in nonlinear two-dimensional electrical lattices, J.F. STORMES, L.Q. ENGLISH, Dickinson College, F. PALMERO, University of Seville, Spain, P.G. KEVREKIDIS, University of Massachusetts, DICKINSON COLLEGE COLLABORATION, UNIVERSITY OF SEVILLE COLLABORATION, UNIVERSITY OF MASSACHUSETTS COLLABORATION — We report on the generation of stationary and traveling intrinsic localized modes (ILMs), also called discrete breathers or discrete solitons, in two dimensions in damped-driven electrical lattices. ILMs are spatially localized eigenmodes that arise due to the nonlinearity of the system, not due to spatial impurities. Since solitons are generally unstable in two dimensions, the existence of these ILMs relies on the discreteness of the lattice. We show experimentally that depending on the frequency and amplitude of the spatial uniform driving, different numbers of ILMs can be induced in both square and hexagonal lattices. In lattices that allow ILM motion, we furthermore study the interaction of such modes.

1:03PM B46.00010 Thermal effects of laser illumination on coated quartz crystal microbalance surfaces1, BENJAMIN KELLER, KEELEY STEVENS, LIMING PAN, JACQUELINE KRIM, North Carolina State University — Prior work on the thermal sensitivity of quartz crystal microbalances (QCMs) has shown [1] that laser heating can be used as a heat source to heat QCMs to milli-Kelvin temperature impulses while also presenting a well-understood response to steady state heating [2]. Here we present a novel application wherein a laser is focused onto the coated QCM, thus applying a non-contact thermal pulse. By applying variable length (second to minute) exposures from a laser source we can isolate the thermal shock, time decay and gross heating effects. The system is sensitive to the coating used, showing significant differences in heating for absorptive and reflective coatings. This method is unique in that the QCM measures energy lost into the substrate, unlike standard techniques which focus primarily on material efficiency. This has potential to characterize various coatings used in solar cells and thermal collectors, as well as in photovoltaic materials.


3Funding provided by NSF DMR.

1:15PM B46.00011 Spectrum, symmetries, and dynamics of Heisenberg spin-1/2 chains, KIRA JOEL, DAVIDA KOLLMAR, LEA SANTOS, Yeshiva University — Quantum spin chains are prototype quantum many-body systems. They are employed in the description of various complex physical phenomena. Here we provide an introduction to the subject by focusing on the time evolution of Heisenberg spin-1/2 chains with couplings between nearest-neighbor sites only. We study how the anisotropy parameter and the symmetries of the model affect its time evolution. Our predictions are based on the analysis of the eigenvalues and eigenstates of the system and then confirmed with actual numerical results.

1:27PM B46.00012 High temperature series expansion and the exact solution study of the 1/5 depleted square lattice Ising model1, SIMEON HANKS, TRINANJAN DATTA, Augusta State University. JAAN OITMAA, The University of New South Wales — The critical behavior of the 1/5 depleted square-lattice Ising model with nearest neighbor ferromagnetic interaction has been investigated by means of both a high-temperature series expansion and an exact solution. The critical point in the coupling constant has been accurately determined with a series expansion up to order eighteen in the high temperature expansion parameter. For the exact solution we used a set of decoration transformations to recast the original model in terms of a set of nearest neighbor, next-nearest neighbor, and four spin interaction Ising model. This is followed by a transformation to a staggered 8-vertex model. As the vertex weights satisfy the free-fermion condition the free energy and critical point are obtainable by standard methods.

1Cottrell Research Corporation Grant No 20073
Surface-induced reduction of the spin coherence times of nitrogen-vacancy centers in diamond. JEFFREY M. MOORE, MICHAEL E. FLATTÉ, Department of Physics and Astronomy, University of Iowa — The exceptionally long room-temperature spin coherence times of nitrogen-vacancy (NV) centers in diamond indicate their potential utility for quantum information processing. The remarkable sensitivity of the spin dynamics of NV centers to electric and magnetic fields, and to strain, also suggests these centers can be used in novel sensors. The sensitivity and spatial resolution of such a sensor will depend on the depth of the NV center below the diamond surface. Local relaxation of the atomic positions near the diamond surface, however, will strain the NV center and consequently reduce its spin coherence time. We evaluate this effect by calculating the strain near a (001) diamond surface using density functional theory. The strain for a specific NV-center depth was evaluated using the linearized augmented plane wave (LAPW) method and the Perdew-Burke-Ernzerhof (PBE) exchange correlation functional within the WIEN2k density functional code. The effect of the resulting strain values on the spin coherence times were determined using a low-energy effective Hamiltonian for the NV-center spin system and wave functions, and their strain dependence. This work was supported by an AFOSR-MURI.

Density of States of Type-II Superconductors in High Magnetic Field and Low Temperatures. RENZO VILLAZON, OWEN LEHMER, JULIAN IRWIN, SASHA DUKAN, Goucher College, Baltimore, MD 21204 — In high magnetic fields and at low temperatures, electronic energies are quantized in the form of Landau levels. The inclusion of Landau level quantization in the superconducting pairing (both diagonal and off-diagonal) leads to gapless points on the Fermi surface. Within this theory, the density of states of a type-II superconductor in the range of magnetic fields 0.2B<C<2B<C is calculated. The influence of disorder on the density of states is investigated for a range of impurity concentrations and scattering potential strengths. We compare our theoretical predictions to experimental results for superconductor YNi2B2C and find that our model is reliable at high magnetic fields but has limited applicability at lower fields.

X-ray Magnetic Circular Dichroism Study of La1−xSr5MnO3 Thin Films. XIILEI KUANG, ZHUYUN XIAO, Bryn Mawr College, EUN JU MOON, STEVEN MAY, Drexel University, DAVID KEAVNEY, YAOHUA LIU, Argonne National Laboratory, X.M. CHENG, Bryn Mawr College — The perovskite manganite La1−xSr5MnO3 (LSMO) has attracted great attention recently due to its fundamental physics and potential applications in spintronics and data storage. In this work, we report a temperature-dependent x-ray magnetic circular dichroism (XMCD) study of epitaxial LSMO thin films deposited on orthorhombic NdGaO3 (NGO) substrates grown by the molecular beam epitaxy (MBE) method. Small angle x-ray reflectivity and atomic force microscopy (AFM) results confirmed good epitaxial quality. XMCD measurements were performed at beamline 4-ID-C of the Advanced Photon Source at Argonne National Laboratory. XMCD spectra were taken in a 0.5 tesla field at temperatures ranging from 5 K to 180 K after the 0.5 tesla field cool. The total electron yield absorption spectra showed the oxide state characteristics of Mn, and the shapes of the Mn and O dichroism spectra change with temperature.

Properties of Ti5C3 thin films created at different temperatures using magnetron sputtering. CHRISTOPHER ROTELLA, JEFFREY HETTINGER, EMMA CORTES, SAMUEL LOFLAND, Rowan University Department of Physics and Astronomy, MIN HEON, Drexel University Department of Materials Science, CARL LUNK, Rowan University Department of Physics and Astronomy — We were able to create thin films of Ti5C3 on c-axis oriented single crystal Al2O3 using both co-deposition magnetron sputtering and reactive magnetron sputtering. While TiC is generally used as a precursor film when making “on-chip” cold pressure tensor

Iron oxide nanocrystals (NCs) have been the focus of intense research owing to the observation of tunable magnetic properties which could lead to advances in many fields including magnetic storage devices and medicine. We have been targeting the use of iron oxide NCs as magnetoresistance (MR) based sensors using ordered NC arrays. In this work, we will present our efforts toward using external magnetic fields to induce intraparticle ordering in iron oxide NC drop cast films. We use x-ray diffraction to analyze effects of the external fields on the NC array structure, while using SQUID magnetometry to probe the effects of NC interactions on the magnetic properties of iron oxide NCs ranging from 5 - 20 nm in diameter. MR measurements suggest large changes in the MR ratio can be achieved using the directed ordering approach for NC arrays. Our work could provide new avenues towards the fabrication of new magnetic devices.
3:18PM C46.00005 Photocatalysis of Thin Films of TiO$_2$ on Al$_2$O$_3$ Substrates$^1$. DAVID TURBAY, Brown University, TIMOTHY LUTTRELL, MATTHIAS BATZILL, University of South Florida — Titanium dioxide (TiO$_2$) has grown to be one of the most promising photocatalysts in recent years because of extensive applications in renewable and clean energy. The rise in demand for these new energies has driven an increase in research on metal oxides and their properties. Our interest in growing the rutile structure of TiO$_2$ stems from its lower excitation energy (3.0 eV) when compared to anatase (3.2 eV), which indicates it has better activity in the visible portion of the spectrum. It has been shown that sapphire (Al$_2$O$_3$) substrates are conducive to epitaxial rutile growth. In this study, we measured the photocatalytic activity of thin films of TiO$_2$ on r-Al$_2$O$_3$ (1 -1 0 2) substrates. We used PLD and MBE to grow the films, which were characterized using XPS and AFM. Photoactivity was measured via the decomposition of methyl orange on the film’s surface using a UV/VIS spectrophotometer. The decomposition of this organic compound is driven by oxidation-reduction reactions on the surface of the TiO$_2$ film. From this, we calculated the charge carrier diffusion length and compared it to that of anatase.

$^1$Funding provided by NSF Grant DMR-1004873

3:30PM C46.00006 Synthesis and Characterization of Ni-NiO Nanocomposites for Optoelectronic Applications. G. BEAVER, A. LAUDARI, K. GHOSH, Missouri State University — LEDs and solar cells are becoming increasingly ubiquitous in modern society as they offer low energy consumption in a world where energy concerns are becoming increasingly prominent. Nonetheless, these devices have to overcome several shortfalls before they will be able to effectively replace traditional devices. In particular, these devices are fabricated using diodes, which depend on p-n junctions. While n-type oxide semiconductors are relatively plentiful, p-types are harder to produce. This research attempts to create a p-type oxide semiconductor with long lifespan and low resistivity. Using pulse laser deposition, NiO thin films with Ni nanoparticles were fabricated on quartz and Al$_2$O$_3$ substrates. Detailed structures of the thin films were studied by X-Ray diffraction, scanning electron microscopy, and Raman spectroscopy techniques. Physical parameters such as magnetic moment of nickel, carrier concentration, and bandgap have been estimated using ultra violet-visible spectroscopy, photoluminescence, Hall effect, and magnetization data. Detailed results will be discussed in the presentation. This work is supported by NSF (Award Number DMR-0907307).

3:42PM C46.00007 ABSTRACT WITHDRAWN.

3:54PM C46.00008 Experimental and analytical study of ionic self-assembly of silica and titania nanoparticles. BRIAN SIMPSON, WILL BANKS, VINCENT KIM, ANDREW SEREDINSKI, KATY WILSON, IRINA MAZILU, DAN MAZILU, Washington and Lee University — Using the ionic self-assembled monolayers (ISAM) technique we investigate the time dependence of the surface coverage of thin films that consist of alternating layers of silica or titania nanoparticles deposited on polymer substrates. We conduct experiments in order to investigate the significant observable factors that affected the quality of the coatings including the dipping time, pH, and the polarity of the silica, titania, and PDDA solutions. Using SEM micrographs, we analyzed the surface coverage and compared it to analytical results obtained using a cooperative sequential adsorption model.

4:06PM C46.00009 Nanoscale Thermal Analysis of Organic Solar Cells. KYLE KELLEY, EITAN LEES, CORTNEY BOUGHER, TONYA COFFEY, BRAD CONRAD, Appalachian State University, PATRICK HEAPHY, CHRIS COLLISON, SUSAN SPENCER, JEREMY CODY, Rochester Institute of Technology — Our research uses atomic force microscopy (AFM) and a Nanoscale Thermal Analysis (NanoTA) system from Anasys Instruments to correlate the morphology of local structures with the thermal material properties of organic solar cells. The NanoTA system uses AFM probes that can be heated up to 350°C over a 50 nm region to quantify the melting transition temperatures of nanoscale regions. We show results for two semiconductors, D$_2$PSQ[OH]$_2$ and PCBM, for low, high, and systematically blended thin-films. We have characterized the morphology and melting points of the blend films with increasing anneal time, and differences in melting points of blended as compared to pure samples.

4:18PM C46.00010 Characterization of organic solar cell morphology. EITAN LEES, KYLE KELLY, CORTNEY BOUGHER, Appalachian State University, SUSAN SPENCER, PATRICK HEAPHY, JEREMY CODY, CHRISTOPHER COLLISON, Rochester Institute of Technology, TONYA COFFEY, BRAD CONRAD, Appalachian State University — The morphology of organic solar cell bulk heterojunctions were characterized using atomic force microscopy (AFM). The RMS roughness of solar cells composed of 1,3-bis[4-(N,N-diisopentylamino)-2,6-dihydroxyphenyl]squaraine [DIPSQ(OH)$_2$] and phenyl(C$_6$H$_4$)-butyric acid methyl ester [PCBM] through spin casting were measured. Solar cells of various blend concentrations, anneal times, and cooling methods were characterized. Through RMS roughness analysis we can study the crystallization process in solar cell fabrication. Morphology will be related to device characterization.

4:30PM C46.00011 Computational study of a class of cooperative sequential adsorption models on Cayley trees and two-dimensional lattices. WILL BANKS, ANDREW SEREDINSKI, BRIAN SIMPSON, VINCENT KIM, IRINA MAZILU, DAN MAZILU, Washington and Lee University — We present a Monte Carlo simulation study of a class of cooperative sequential adsorption models with constant and variable attachment rates and their possible applications for ionic self-assembly of thin films, drug encapsulation of nanoparticles and susceptible-infected-recovered epidemic models. We do a comparison study of these models on a Cayley tree and a two-dimensional lattice and discuss the cases for which four-branch Cayley trees are good approximations for two-dimensional lattices.

4:42PM C46.00012 Characterization of Ion Movement in Light-Emitting Electrochemical Cells via ToF-SIMS. TYKO SHOJI, Department of Physics and Astronomy, Western Washington University, Bellingham, WA, USA, ZIHUA ZHU, Environmental Molecular Sciences Laboratory, Pacific Northwest National Laboratory, Richland, WA, USA, ANTON ILKEVICH, Department of Chemistry, Western Washington University, Bellingham, WA, USA, JANELLE LEGER, Department of Physics and Astronomy, Western Washington University, Bellingham, WA, United States — An emerging advantage of organic semiconductors is their ability to conduct ions in applications such as light-emitting electrochemical cells (LECs), photovoltaic devices, and electrochromic devices. This ability of organic materials to conduct both ionic and electronic currents in the solid state sets these materials apart from their inorganic counterparts. However the fundamental electrochemical processes are not well characterized. Evidence suggests that the profiles of ions and electrochemical doping in the polymer film during operation significantly impact the performance and stability of the device. Here, we present our findings from direct profiling of ion distributions in LECs following application of voltage, via time-of-flight secondary ion mass spectrometry. Ion distributions were characterized with regard to film thickness, salt concentration, applied voltage, and relaxation over time. Results provide insight into correlation between ion profiles and device performance and potential approaches to tuning electrochemical doping processes in LECs.
4:54PM C46.00013 Asymmetric laser sideband generation with a tapered semiconductor amplifier

1. MICHAEL LENZAKS, MICHAEL LIM, Department of Physics and Astronomy, Rowan University — We have constructed a free-space, frequency-shifted feedback amplifier using a tapered semiconductor gain element. The general layout of the system is similar to that described in Littler, et al., Opt. Comm. 88, 523 (1992). Traveling-wave feedback is demonstrated with the m = −1 order of several different acousto-optic modulators driven at variable frequency. Asymmetric sideband production is observed in the rf spectrum of a fast photodiode and in the transmission of a scanning Fabry-Perot interferometer. The number of asymmetric modes is controlled with the AOM rf drive power and the seed laser optical power.

3Supported by NSF PHY-0613659

5:06PM C46.00014 Synchronization in a network of phase-coupled oscillators: the role of learning and time delay

1. LIAM TIMMS, LARS ENGLISH, Dickinson College — We investigate numerically the interplay of network “learning” and finite signal speed in one and two-dimensional arrays of coupled Kuramoto oscillators. The finite signal speed is introduced into the dynamical system via a time-delay in the coupling. The network structures we examine include various one and two-dimensional arrays with both long and short-range connectivity; the structure of these arrays is imposed via a time delay and a connection matrix. The learning is governed by the Hebbian learning rule which allows the coupling strengths between pairs of oscillators to vary dynamically. It corresponds to a neurological type of learning in which the synapses between neural oscillators increase in strength when they fire action potentials together. We explore the coherent spatio-temporal patterns that can emerge as a function of model parameters such as learning rate and signal speed.

Tuesday, March 19, 2013 8:00AM - 10:48AM —
Session F46 SPS: SPS Undergraduate IV Hilton Baltimore Holiday Ballroom 5 - Crystal Bailey, American Physical Society

8:00AM F46.00001 Density Functional Study of the structural properties in Tamoxifen

1. ROMEO DE COSS-MARTINEZ, JORGE A. TAPIA, Facultad de Ingenieria, Universidad Autonoma de Yucatan, RAMIRO F. QUIJANO-QUIÑONES, Laboratorio de Quimica Farmaceutica, Facultad de Quimica, Universidad Autonoma de Yucatan, GABRIEL I. CANTO, Centro de Investigacion en Corrosion, Universidad Autonoma de Campeche — Using the density functional theory, we have studied the structural properties of Tamoxifen. The calculations were performed with two methodological approaches, which depend on a chemical and biological background. For Siesta, we considerate a linear combination of atomic orbitals (LCAO) method, using pseudopotentials and the van der Waals approximation for the exchange-correlation potential. Here we analyzed and compared the atomic structure between our results and other theoretical study. We found differences in the bond lengths between the results, that could be attributed to code approaches in each one.

This work was supported under Grant FOMIX 2011-09 N: 170297 of Ph.D. A. Tapia.

8:12AM F46.00002 Cytotoxicity of Gold Nanoparticles with Varying Concentration and Under Low Dose Environmental Radiation on Human Embryonic Kidney 293 Cells (HEK-293)

1. SHALANA CRUDUP, BRUCE BRAEMBER, Rowan University, CRISTINA IFTODE, Rowan University, Dept. of Biological Sciences, TABBETHA DOBBS, Rowan University, Dept. of Physics & Astronomy — Nanomaterials are increasingly being used in medicine. Most research surrounding the health and safety effects of nanomaterials examine the cytotoxicity of nanoparticles alone. Few studies, as this one does, examines the combined effects of nanoparticle concentration and radiation exposure on cytotoxicity to human embryonic kidney 293 cells (HEK-293). Nanoparticles injected in the body are supposed to undergo biodegradation once they are done their specified task, however, some do not and accumulate in the cells (particularly at the liver and kidney) and this causes intracellular changes. Examples of intracellular changes are the disruption of organelle integrity or gene alterations. This will cause the cells to die because the cells are very sensitive to changes in their pH. The experiments reported here focus on the cytotoxicity of gold nanoparticles as a function of varying particle concentrations and also with and without exposure to UV radiation.

8:24AM F46.00003 Migration Modes in Cancer Cell Motility

1. DI WU, HELIM ARANDA-ESPINOZA, University of Maryland, College Park — Cancer cell metastasis is a result of secondary tumor proliferation after single or collective cancer cell migration from a primary tumor. The biophysical mechanisms of cancer cell migration and transmigration through the body vasculature, while investigated, is not extensively quantified. In general, directed cell motility is traditionally viewed as the result of lamellipodia generation through which the cell moves by extending an actin protrusion and adhesion beneath its plasma membrane. However, cancer cells also exhibit motility through blebbing, which involves momentary membrane detachment from the actin cortex, membrane expansion and retraction. While blebbing, cancer cells do not form cell-substrate attachments as with lamellipodia. In vitro studies of single cancer cell migration through microfluidic microchannels of constant or linearly changing widths model in vitro conditions of single cell migration through capillary pores. We study both modes of motility and observe that cancer cell migration using lamellipodia or blebbing depends on channel width. Drug treatments to manipulate the cytoskeleton demonstrate that cancer cell migration changes speed but not the mode of migration.

Human Frontier Science Project Award - RGP00582011

8:36AM F46.00004 Developing a Novel, Interdisciplinary Approach to Study Protein Unfolding

1. IAN BENTLEY, Department of Biology, Xavier University, Cincinnati, OH, JUSTIN LINK, Department of Physics, Xavier University, Cincinnati, OH — The ability of a protein to function is a direct result of its ability to properly obtain its native, folded structure. In order to determine the structural stability of proteins and to gain knowledge of their folding mechanism, we must develop protocols that allow us to monitor the controlled unfolding of proteins. Here, we investigate the stability of cytochrome c, a well-studied, model protein, under denaturing conditions using circular dichroism (CD) and fluorescence. Using methods such as circular dichroism and fluorescence, we have begun to ensure that our CD spectra can provide insight into the stability of proteins by providing us with thermodynamic parameters such as the Gibbs free energy, melting temperature and enthalpy. Research in this lab has been explored with mutant proteins and change in CD signal, however further work must still be done to observe their unfolding monitored by fluorescence. This technique will allow us to determine which regions of native cytochrome c have the greatest impact on the protein folding process. The objective of this session is to present recent work in developing a protocol to observe the unfolding of wild type and mutant proteins with fluorescence.

The Borzer Fund, The John A. Hauck Foundation, and Xavier University
8:48AM F46.00005 Optimization of radiation damage to proteins using X-ray nanofocusing optics1, SELWA BOULARAOUI, KUSTAR - Khalifa University, K. EVANS-LUTTERODT, BNL-NSLS, S. LEE, A.F. ISAKOVIC, KUSTAR - Khalifa University — The need to understand protein structure and perform treatment lead to the use of X-ray and particle-based radiation. Since the use of such radiation has undesirable side effects, mostly through the damage to proteins, it is important to continuously work on decreasing radiation damage. We outline the proposal to use the kinoform refractive optics to focus X-rays on the nanoscale to minimize the radiation damage to protein crystals under study. These optics devices are nanofabricated from low-Z elements (silicon, diamond) and can be used at synchrotron X-ray radiation facilities. We discuss the automated setup that performs nanopositioning of the nanofocusing element, and collects the chemical and structural protein solution under study. We offer simple mathematical models in irradiation and in treatment that help optimize the radiation parameters.

1This work is supported in part by Khalifa University IRF-Level 1 Fund. The work at BNL-NSLS is supported through US DOE, Office of Basic Energy Sciences.

9:00AM F46.00006 Driving Sodium-Potassium Pumps With An Oscillating Electric Field: Effects On Muscle Recovery In The Human Biceps Brachii1, MATT BOVYN, Northern Arizona University, WEI CHEN, University of South Florida, OLIVIA LANES, Dickinson College, JASON MAST, University of South Florida — Dr. Chen has developed a technique called synchronization modulation, which uses an oscillating electric field to increase the rate at which the sodium-potassium pumps in the cell membrane work. Because the sodium-potassium pump is integral in the recovery of skeletal muscle fibers after an action potential, we investigated the effects of applying synchronization modulation to muscles which had already undergone fatigue due to repeated action potentials during exercise. Fatigue was induced in human subjects' biceps brachii through isometric contraction. Surface electromyography measurements of fatigue index were used to quantify how the muscle recovered over the minutes following fatigue, both when synchronization modulation was applied and when it was absent. The preliminary results were inconclusive, but it is hoped that in later work it will be shown that applying synchronization modulation is effective in increasing the rate at which the muscle recovers to its initial state. This would demonstrate not only that synchronization modulation can be successfully applied to human muscle, but also that it has many potential applications in sports medicine and novel disease treatments.

1Work done as part of an REU program at the University of South Florida

9:12AM F46.00007 Driving Sodium/Potassium Pumps with an Oscillating Electric field: Effects on Muscle Fatigue, OLIVIA LANES, Dickinson College, MATTHEW BOVYN, North Arizona State University, WEI CHEN, University of South Florida — Dr. Chen has developed a technique called Synchronization Modulation, which has already proven to be an effective tool in synchronizing and speeding up the sodium/potassium pumps in cell membranes. When synchronized, it is thought that these pumps are more efficient because they require less ATP. We hypothesized that if this was correct, this technique may be used to reduce muscle fatigue. To test our hypothesis, we had multiple test subjects hold a 15 lb weight for as long as they could while isolating the bicep muscle and applying an oscillating electric field. We compared the EMG data we took during these trials to the control, which was done the same way but without applying the electric field. To compare how fatigued subjects were, we did a Fast Fourier Transform on the first and last 10 seconds of each trial to measure the Fatigue Index. Our preliminary results suggest that the Fatigue Index decreased at a slower rate in the trials where the subject held the weight with Synchronization Modulation.

9:24AM F46.00008 Multiscale MD Simulations of Folding Dynamics and Mobility of Beta-Amyloid Peptide on Lipid Bilayer Surfaces1, SCOTT VAN TILBURG, KELVIN CHENG, Trinity University — Early interaction events of beta-amyloid peptides with the neuronal membranes play a key role in the pathogenesis of Alzheimer’s disease. We have used multiscale Molecular Dynamics (MD) simulations to study the protein folding dynamics and lateral mobility of beta-amyloid protein on the cholesterol-enriched and -depleted lipid nano-domains. Several independent simulation replicates of all-atom and coarse-grained MD simulations of beta-amyloid on different lipid bilayer nano-domains have been generated. Using Define Secondary Structure of Proteins (DSSP) algorithm and mean-square-distance (MSD) analysis, the protein conformation and the lateral diffusion coefficients of protein, as well as the lipid and water, were calculated as a function of simulation time up to 200 nanoseconds for atomistic and 2 microseconds for coarse-grained simulations per replicate in different bilayer systems. Subtle differences in the conformation and mobility of the protein were observed in lipid bilayers with and without cholesterol. The structural dynamics information obtained from this work will provide useful insights into understanding the role of protein/lipid interactions in the membrane-associated aggregation of protein on neuronal membranes.

1HHMI-Trinity University and NIH RC1-GM090897-02

9:36AM F46.00009 The structure of immiscible lipid phases as revealed by the Anton special purpose supercomputer, MICHAEL SANDAR, Department of Physics and Astrophysics at the University of Delaware, EDWARD LYMAN, Department of Physics and Astrophysics and Department of Chemistry and Biochemistry at the University of Delaware — We present simulation data for a bilayer composed of a ternary mixture of cholesterol, dioleoyl phosphatidylcholine and dipalmitoyl phosphatidylcholine. The chosen composition is in the two-phase region and the temperature is in the vicinity of the miscibility transition. Using the Anton special purpose supercomputer to generate continuous trajectories longer than ten microseconds—which admits complete lipid mixing—we observe robust liquid-liquid phase coexistence. We characterize the phase separated state by considering the local composition fluctuations. Correlation functions of the position reveal that the structure of the domain is circular on average, but that the boundary is subject to significant fluctuations, as expected in the neighborhood of a critical point. The domain diffuses on a slower timescale than the lipids, but by way of lipid exchange, rather than as a well-defined cluster.

9:48AM F46.00010 Computational Analysis of ECGs, KEVIN WATERS, Indiana State University — Electrocardiogram is among the most powerful methods at present to diagnose heart conditions. Here we employed Fourier transform to analyze Electrocardiograms. The goal of the project is to find a way to isolate different wave signals in ways that today’s technology is not capable of. Our focus was on building on a code that is capable of filtering out P, QRS, T waves and noise from the ECG, so we created frequency filters that omitted selected amount of data. We first deconstructed and then constructed the ECG this way to find an optimal code assembly for each ECG wave (P-wave, QRS-wave, T-wave). By focusing on one patient, we succeeded to disentangle the complicated ECG signal. We plan to extend this method to more patients.
where these particles may be added to direct treatment to various parts of the body and across the cell wall membrane by an applied magnetic field. We apply this technique in Digital Holography experiments. We were able to get clear images of resolution targets and our future work will be to image retina samples using spatially non-coherent light and apply this technique in Digital Holography experiments.

10:12AM F46.00012 Imaging The Genetic Code of a Virus1, JENNA GRAHAM, JUSTIN LINK, Department of Physics, Xavier University, Cincinnati, OH — Atomic Force Microscopy (AFM) has allowed scientists to explore physical characteristics of nano-scale materials. However, the challenges that come with such an investigation are rarely expressed. In this research project a method was developed to image the well-studied DNA of the virus lambda phage. Through testing and integrating several sample preparations described in literature, a quality image of lambda phage DNA can be obtained. In our experiment, we developed a technique using the Veeco Autoprobe CP AFM and mica substrate with an appropriate absorption buffer of HEPES and NiCl2. This presentation will focus on the development of a procedure to image lambda phage DNA at Xavier University.

1The John A. Hauck Foundation and Xavier University

10:24AM F46.00013 Single Molecule Study on the Direct Transfer of E. coli Single-Stranded Binding protein between Single-Stranded DNA Molecules1, TECKLA AKINYI, Department of Physics, Xavier University, Cincinnati, OH, I-REN LEE, TAEKJIP HA, Department of Physics, University of Illinois at Urbana-Champaign — Single molecule fluorescence resonance energy transfer (smFRET) techniques allow a direct study of the mechanism of the spontaneous transfer of Escherichia coli Single-Strand Binding (SSB) protein from single-stranded DNA to a competitor single-strand (ss)DNA. This investigation attempts to understand the kinetics of dissociation and ultimately figure out how long can SSB remain bound to ssDNA in midst of competitor free ssDNA. Application of single molecule techniques as described by Taekjip Ha, (Ha, Methods 25, 78–86 (2001)) allow the quantification of the rapid dissociation of SSB from ssDNA as a function of ssDNA length and concentration. We also examined, whether the dissociation occurs with the SSB subunits released simultaneously or consecutively with the possibility of an intermediate state. The variation of dissociation time with DNA length and concentration of the competitive ssDNA demonstrate direct proportionality implying SSB is transferred between ssDNA molecules with a ratio of 1:1, with an abrupt transition from a high FRET state to a low FRET state indicating instantaneous dissociation limited by our time resolution.

1HHMI and NSF, Center for the Physics of Living Cells

10:36AM F46.00014 Images of Cone Photoreceptors Using Spatially Non-Coherent Light1, ALLISON HARTMAN, College of the Holy Cross. CHANGGENG LIU, MYUNG KIM, University of South Florida — In order to get clear images of the photoreceptors in a living human eye, we constructed a collimated beam of light with controllable spatial coherence. In the past, imaging techniques using coherent light have shown interference speckles that are the similar size and shape as photoreceptors; these experiments have been unable to differentiate the speckles and the photoreceptors that are in the retina of the eye. We used MatLab to create a simulation of the optical system using a light source with variable spatial coherence reflecting off of a resolution target and we were able to eliminate the speckle patterns. We then created an experimental setup to verify our simulation. We were able to get clear images of resolution targets and our future work will be to image retina samples using spatially non-coherent light and apply this technique in Digital Holography experiments.

1I would like to thank the National Science foundation for funding this project and University of South Florida and the Digital Holography and Microscopy Lab for hosting me.

Tuesday, March 19, 2013 11:15AM - 1:39PM — Session G46 SPS: SPS Undergraduate V Hilton Baltimore Holiday Ballroom 5 - Kendra Redmond, American Institute of Physics

11:15AM G46.00001 Reverse Micelle Synthesis of Gadolinium Nanoparticles1, R.H. FUKUDA, M.M. CASTRO, P.-C. HO, Department of Physics/California State University, Fresno, S. ATTAR, M. GOLDEN, Department of Chemistry/California State University, Fresno, D. MARGOSAN, United States Department of Agriculture - Agriculture Research Service — Nanotechnology is an area of great interest due to its variety of applications such as nano-medicine. The reverse micelle method has been used to synthesize Gd nanoparticles by our research group. Through this method, a surfactant protectively cages particles of Gd in the presence of polar methanol and nonpolar hexane. This method can control particle size by growth temperature and the molar ratio of polar solvent to surfactant. The Gd was reduced from its chloride compound by using sodium borohydride. The final products have been achieved either through a method of liquid liquid extraction or filtration. Scanning electron microscopy (SEM) paired with energy dispersive x-ray spectroscopy (EDX) was used to examine the size, shape, and composition of the products. The size and shape were also examined using a Leica light microscope between SEM analyses. We found that liquid liquid extraction does not work in the solvent combination of methanol-hexane due to the instability of the reverse micelles. Additionally, the process of carbon coating SEM samples may have destroyed the reverse micelle structures.

1Research at CSU-Fresno is supported by NSF DMR-1104544. Ryan Fukuda is also supported by Undergraduate Research Grant and Faculty- Sponsored Student Research Award at CSU Fresno.

11:27AM G46.00002 Ferromagnetic Nanoparticles for Biomedical Applications , FRANK HOLDER, Rowan University, Dept. of Physics & Astronomy, CRISTINA IFTODE, Rowan University, Dept. of Biological Sciences, TABBETHA DOBBINS, Rowan University, Dept. of Physics & Astronomy — This work examines the cytotoxicity of barium hexaferrite to fibroblasts (HEK-293) cells and also the response of barium hexaferrite to magnetic fields. Cytotoxicity is a great way for pharmacies to measure for toxic compounds. Cytotoxicity assays are widely used by the pharmaceutical industry to screen new compounds which may be introduced to the cells. Results show the cytotoxicity of nanoparticles of barium hexaferrite. We chose barium hexaferrite because it is a magnetic material—so it can be driven using an applied magnetic field. This would be useful in biomedical applications where these particles may be added to direct treatment to various parts of the body and across the cell wall membrane by an applied magnetic field.
11:39AM G46.00003 Morphological, Thermal, and Magnetic Analysis of Ball-Milled $\gamma$-Fe$_2$O$_3$ and Fe$_3$O$_4$ Nanoparticles for Biomedical Application. PHILIP BURNHAM, GEORGIA C. PAPAETHYMIUOU, ARTHUR VIECAS, Villanova University, Department of Physics, CALVIN LI, Villanova University, Department of Mechanical Engineering, NORMAN DOLLAHON, Villanova University, Department of Biology — Superparamagnetic iron oxide nanoparticles are promising agents for hyperthermia cancer treatment, because, when exposed to an alternating magnetic field, they impart heat to surrounding tissue. A comparison of $\gamma$-Fe$_2$O$_3$ and Fe$_3$O$_4$ nanoparticles for such application is presented. The particles were obtained via surfactant-assisted high energy ball-milling in a hexane/oleic acid carrier-fluid environment. Particles with diameters of 5 to 16 nm were prepared with mass ratios (oleic acid):(Fe$_2$O$_3$) of 0:1, 1:5, 1:10 and 1:20, with milling times of 3, 6, 9, and 12 hours. TEM micrographs revealed spherical morphology and the effect of oleic acid shells. Optimal size distributions were obtained for high oleic acid contents. At room temperature, a reduced internal magnetic field (∼480 kOe) was recorded via Mössbauer spectroscopy compared to bulk $\gamma$-Fe$_2$O$_3$ (∼500 kOe), due to magnetic relaxation; Fe$_3$O$_4$ particles produced similar results. For the $\gamma$-Fe$_2$O$_3$ and Fe$_3$O$_4$ nanoparticles with 20% oleic acid by mass, comparative ZFC/FC magnetization ($H_{app}$ = 200 Oe in temperature range from 2 to 400 K) and hysteresis loops ($T = 2$ K and 300 K up to $H_{app} = 6$ kOe) were obtained. Thermal transport characteristics were verified by Specific Absorption Rate (SAR) measurements using an AC magnetic field ($f=282$ kHz). Differences and similarities in behavior will be discussed.

11:51AM G46.00004 Multi-scale Size Distributions of Colloidal Gold Clusters Measured by Ultrasmall Angle X-ray Scattering (USAXS) and Dynamic Light Scattering (DLS). ASHLI NIEVES, Rowan University, JAN ILAVSKY, Advanced Photon Source, Argonne National Laboratory, TABBETHA DOBBINS, Rowan University — Gold colloids are of interest as: (1) catalysts for energy conversion and (2) absorption agents for laser photothermal therapy. This research examines the agglomerate sizes (using DLS) and primary particle sizes (using USAXS) for gold nanoparticles synthesized by trisodium citrate reduction of gold chloroauric acid (HAuCl$_4$). USAXS data was collected at the Advanced Photon Source, beamline 15ID-D. Model fitting of the data show primary particle sizes of 7nm to 14nm formed. DLS results show these particles to aggregate into a bimodal set of clusters centered on approximately 20nm and approximately 200nm. Preliminary results aimed at effectively breaking apart these aggregates are presented.

12:03PM G46.00005 Dynamical properties of colloids immersed in a uniform electric field at high densities. MATTHEW WOZNIACKI, MANUEL VALERA, ATHULA HERAT, Department of Physics & Pre-Engineering, Slippery Rock University — In light of the recent interest in the control of colloidal systems, we have explored specific properties of electrically interacting colloidal particles. We explored the structural and dynamical characteristics of mono-disperse systems of colloidal particles that are affected by dipole-dipole interactions while immersed in a uniform electric field and compared with the outcomes that could occur if different sizes of particles are mixed. We used molecular dynamics simulations to study the systems. We present results for the diffusion coefficient and other dynamical properties in the high density regime.

12:15PM G46.00006 Synthesis and Characterization of Mg-doped ZnO Nanorods for Biomedical Applications. H. GEMAR, N.C. DAS, A. WANEKAYA, R. DELONG, K. GHOSH, Missouri State University — Nanomaterials research has become a major attraction in the field of advanced materials research in the area of Physics, Chemistry, and Materials Science. Bio-compatible and chemically stable metal nanoparticles have biomedical applications that include drug delivery, cell and DNA separation, gene cloning, magnetic resonance imaging (MRI). This research is aimed at the fabrication and characterization of Mg-doped ZnO nanorods. Hydrothermal synthesis of undoped ZnO and Mg-doped ZnO nanorods is carried out using aqueous solutions of Zn(NO$_3$)$_2$.6H$_2$O, MgSO$_4$, and using NH$_4$OH as hydrolytic catalyst. Nanomaterials of different sizes and shapes were synthesized by varying the process parameters such as molarity (0.15M, 0.3M, 0.5M) and pH (8-11) of the precursors, growth temperature (130°C), and annealing time during the hydrothermal Process. Structural, morphological, and optical properties are studied using various techniques such as XRD, SEM, UV-vis and PL spectroscopy. Detailed structural, and optical properties will be discussed in this presentation. This work is partially supported by National Cancer Institute (1 R15 CA139390-01).

12:27PM G46.00007 Study of Thermal Conductivity of Si Nanowires with micro-Raman Spectroscopy. BINGQING LI, Department of Physics, Bryn Mawr College, KATHRYN F. MURPHY, DANIEL S. GIANOLA, Department of Materials Science and Engineering, University of Pennsylvania, X.M. CHENG, Department of Physics, Bryn Mawr College — Nanowires have played an increasingly important role in thermoelectric technology due to their high figure of merit ZT resulting from the reduced thermal conductivity, K, and good electrical conductivity. In this work, we report the measurement of K of individual silicon nanowires (SiNWs) by mapping Raman temperature profiles along the testing wire with the predictions based on diffuse phonon boundary scattering. The dependence of SiNWs' thermal conductivity on engineering stress can provide significant information for nanowires fabrication.

12:39PM G46.00008 Characterization of Carbon Nanotubes Synthesized Using Chemical Vapor Deposition. ANDREW ZEIDELL, SHAWN HUSTON, Appalachian State University, NATHANAEAL COX, BRIAN LANDI, Rochester Institute of Technology, TONYA COFFEY, PHILLIP RUSSELL, BRAD CONRAD, Appalachian State University — Carbon Nanotubes were synthesized using a Chemical Vapor Deposition system with precursor Cyclopentadienyliron Dicarbonyl Dimer and were systematically characterized over a variety of growth conditions using several methods. Scanning Electron Microscopy (SEM) was used to investigate catalyst contamination, tube diameters, growth morphologies, and material alignment. Transmission Electron Microscopy (TEM) was employed to quantify nanotube wall crystallinity and sidewall defects. Raman Spectroscopy was used in conjunction with Thermo-Gravimetric analysis to ascertain the purity levels of each sample. Results are discussed in terms of related precursors and are used to evaluate the efficacy of the precursor and material quality.
12:51PM G46.00009 Bi2Te3 Nanostructure Synthesis on Multiple Substrates¹, NICHA APICHITSOPA, JEROME T. MLACK, NINA MARKOVIC, Johns Hopkins University — The chalcogenide Bi2Te3 is a known and widely used thermoelectric material that has received renewed experimental interest due to the recent discovery of its topologically protected surface states. Nanodevices of this material are particularly interesting because of their high surface-to-volume ratio, which enhances surface-related transport properties by minimizing bulk contributions. Many synthesis processes for Bi2Te3 have been reported, such as Au-catalyzed vapor-liquid-solid mechanism (VLS) and lithographically patterned galvanic displacement (LPGD). The VLS mechanism is much simpler than the highly-controlled LPGD; however, remnant of Au catalyst on the nanostructures can alter their electronic structure, resulting in modification of TI surface. We report the synthesis of Bi2Te3 nanostructures by VLS mechanism without using Au catalyst, which improves the quality of the nanostructures.

¹This work was supported in part by National Science Foundation under DMR-1106167 and DGE-1232825.

1:03PM G46.00010 SAM surface domains of 1-mercaptoundecanoic acid and 1-dodecanethiol mixtures on Au(111) investigated via polarized probes¹, ROSE PASQUALE, Lock Haven University, RESHANI SENEVIRATHNE, Don’s Food Products Inc, INDRAJITH SENEVIRATHNE, Lock Haven University — SAM (Self Assembled Monolayer) surfaces with –COOH terminus is bio active and therefore has many bioengineering applications. However complex devices patterned on surfaces require a deeper understanding of the surface domain architecture of SAMs with multi component mixtures of thiols. Varying concentration mixed solutions of 1-mercaptoundecanoic acid (hydrophilic -COOH end) and 1-dodecanethiol (hydrophobic –R), dissolved in 200 proof Ethanol with total 5mM concentration were prepared. These solutions were used in developing SAMs on clean flat Au(111) on mica. Resulting SAMs surfaces were investigated with regular and custom built positively and negatively polarized AFM (Atomic Force Microscopy) probes via contact, non contact and lateral force mode AFM with topography and phase imaging. Domains of distinct thiols were identified as selective self assembly on step edges and terraces. Surface roughness, corrugation and morphology at each domain were estimated. Total RMS surface roughness is estimated at ∼2.44nm for SAMs with 75% 1-mercaptoundecanoic acid while for SAMs with 25% 1-mercaptoundecanoic acid it is estimated at ∼2.68nm.

¹LHU Nanotechnology Program, PASSHE FPDC (LOU # 2010-LHU-03).

1:15PM G46.00011 Characterization of Nanophosphors for Solid State Lighting Devices Grown by Microwave Plasma Assisted Deposition Process, JEDIDIAH MCCOY, Morningside College, MAREK MERLAK, SARATH WITANACHCHI, University of South Florida — Increasingly, greenhouse farming and urban agriculture are being looked at as a more efficient and more cost effective way to grow produce. Currently the lights used in greenhouses rely on light sources that emit a broad spectrum of light. However, only light at wavelengths around 460 nm (blue) and 670 nm (red) are absorbed by most plants for photosynthesis. Solid state lighting devices can be engineered to produce light to match the needs of the plant while reducing the energy cost. An investigation into the photoluminescence properties of the nanophosphor La2O3:Bi coatings were grown using a microwave plasma growth process. Microwave power and chamber pressure were varied to find the optimum synthesis conditions. Power was varied from 100Watts to 900Watts and chamber pressure varied from 30Torr to 60Torr. The process utilized O2 and CO2 plasma. The nanophosphors were investigated by X-ray diffraction, electron microscopy, and photoluminescent spectroscopy. Photoluminescence was shown to be higher from samples synthesized in a CO2 plasma.

1:27PM G46.00012 Slip, Slide, or Roll?, MIKE TESTA, None — Using an atomic force microscope the research project, “Slip, Slide, or Roll?” investigates rolling and sliding friction on the nanoscale. The findings of this study may be used to develop improved mechanical lubricants and surfaces. Friction may seem like a simple idea that is familiar to everyone, yet scientific literature explaining what dictates the translational modes of nanoscale objects is surprisingly lacking. In the macroscopic world spherical objects energetically prefer rolling over sliding, for nanoscale objects this is not necessarily the case. We are testing the hypothesis that size, surface chemistry, and elastic modulus dictate whether spherical nanoscale objects will slide or roll when a lateral force is applied. In order to understand the conditions that cause nanoscale particles to transition between the two translational modes we precisely manipulate these variables and measure their effects.