36th Semiannual Student Symposium

Friday, December 19, 2008 – Houston Science Center, Room 102

First Prize: $300 Second Prize: $200 Third Prize: $100

CHAIRS: Profs. Wei-Kan Chu, Jack Wolfe

JUDGES: Profs. Feng Chen, Rebecca Forest, Venkat Selvamanikam

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1:00 p.m. **Welcome & Introduction of Chairs & Judges**: Prof. Allan J. Jacobson, Director, T_CSUH

SESSION I Prof. Wei-Kan Chu, Chair

1:10 **Michael Tran**, "Silver Nanocapsules Using Thermo-Responsive Poly-Nipam Cores," *[Prof. T. Randall Lee, Project Leader]*

1:30 **Biao Liu**, "Nano Structures Based Field Ionization and Its Application in Neutron Generators" *[Prof. Wei-Kan Chu, Project Leader]*

1:50 **Qian Wang**, "A Way to Therapeutics: Penetratin" *[Prof. Margaret Cheung, Project Leader]*

2:10 **Kalyan Sasmal,** "Doping Dependency of Superconductivity in Na_xFeAs and $(Sr,K)Fe_2As_2$" *[Prof. Paul C. W. Chu, Project Leader]*

2:30 *10-Minute BREAK*

SESSION II Prof. Jack Wolfe, Chair

2:40 **Feng Shi**, "Generating Large Scale Ordered Quantum Dot Arrays" *[Profs. Gemunu Gunaratne and Pradeep Sharma, Project Leaders]*

3:00 **Bing Lv**, "Synthesis, Structures and Properties of FeAs-Based Superconductors" *[Prof. Arnold Guloy, Project Leader]*

3:20 **Xiang Hu**, "Quasi-Particle Properties in Iron-Based Superconductors" *[Prof. Chin Sen Ting, Project Leader]*

3:40 **Lalithya C. Jayarathna**, "Electro-Optical Properties of Layered CdSe Nanoparticles and 6TN (Sexithiophene Balaform Amphiphiles) Nanocomposites for Device Fabrication" *[Prof. Rigoberto Advincula, Project Leader]*

4:00 Adjournment and deliberation of judges

4:20 Announcement of winners; photos of presenters, chairs and judges

ABSTRACTS

SESSION I Prof. Wei-Kan Chu, Chair

01:10 p.m. **Michael Tran** *[Prof. T. Randall Lee, Project Leader]*

SILVER NANOCAPSULES USING THERMO-RESPONSIVE POLY-NIPAM CORES, Michael Tran. This presentation describes the preparation of silver nanocapsules (~40 nm in thickness) using thermally responsive hydrogel core particles (~800 nm in diameter). These nanocomposites are being developed for use as thermally modulated delivery vehicles capable of responding to temperature changes and or changes in pH. A particularly attractive feature of these nanocapsules is that the thermally sensitive hydrogel core can be activated by exposure to light via exploitation of the strong plasmon absorption of the optically active silver nanoshell. The silver nanoshell is designed to strongly absorb near-infrared light and the core of biocompatible thermo-responsive co-polymer hydrogel is achieved by the radical polymerization of a selected mixture of N-isoproprylacrylamide-co-acrylic acid. The morphology and structure of composite nanocapsules are examined by FE-SEM and TEM. UV-vis spectroscopy was used to analyze the optical properties of the composite nanocapsules. The results conclude that these composite nanocapsules can be reproducibly prepared, and their response to external stimuli are consistent with the targeted objectives for drug-delivery materials.

01:30 p.m. **Biao Liu** *[Prof. Wei-Kan Chu, Project Leader]*

NANO STRUCTURES BASED FIELD IONIZATION AND ITS APPLICATION IN NEUTRON GENERATORS, Biao Liu. The nano structures possess sharp tips, where an externally applied uniform electric field would be intensified to strengths capable of ionizing ambient gas atoms by quantum tunneling. The purpose of our study is to utilize this principle with a deuterium ambient gas to produce a deuterium ion source of high intensity. Deuterium ions from this source will be subsequently accelerated to energies of more than 100 keV and directed towards a tritium (dissolved in titanium) target to produce 14.1 MeV neutrons. Our effort is focused on the optimization of sample parameters such as the aspect ratio, overall size and density of nano tips to achieve a high neutron yield.

01:50 p.m. **Qian Wang** *[Prof. Margaret Cheung, Project Leader]*

A WAY TO THERAPEUTICS: PENETRATIN, Qian Wang. Membrane-penetratin interaction has been investigated recently due to the special ability of penetratin entering cell membranes without causing damages to a cell. With such characteristics, penetratin can be used in better design of drug delivery. The investigation of atomistic interactions between penetratin and micelles that represent membrane properties of human or bacterium will be presented. Using the all-atom molecular dynamics, we assess the binding processes and statistical properties of penetratin by the analysis of the free energy landscape. We find that when interacting with the neutral micelle, helicity of a penetratin reduces. We also compute favorable positions of a penetratin inside micelles, which depends on the chemical details of micelles. Our study explains why penetratin is more reactive to bacteria than a human being.

02:10 p.m. **Kalyan Sasmal** *[Prof. Paul C. W. Chu, Project Leader]*

DOPING DEPENDENCY OF SUPERCONDUCTIVITY IN Na_xFeAs AND $(Sr,K)Fe_2As_2$, Kalyan Sasmal. Systematic doping effects were explored in superconducting Na-Fe-As and $(Sr,K)Fe_2As_2$ systems. Na-Fe-As has Cu_2Sb-like 111 phase which is stable only above a Na stoichiometry of $\approx$0.85, but bulk superconductivity appears only within a narrower range around $Na_{0.9}FeAs$. The NaFeAs (1:1:1) is non superconducting. Such narrow doping dependency of bulk superconductivity is in disagreement with most expectations. The resistivity shows no evidence for SDW in the non-superconducting sample. On the other hand the T_c of KFe_2As_2 and $CsFe_2As_2$ were raised with partial substitution of Sr for K and Cs and peaks at 37 K for 50%–60% Sr substitution, and the compounds enter a spin-density-wave state with increasing Sr content. This represents p-type analogs of the n-doped rare-earth oxypnictide superconductors.

02:30 p.m. **10-Minute BREAK**

SESSION II Prof. Jack Wolfe, Chair

02:40 p.m. **Feng Shi** *[Profs. Gemunu Gunaratne and Pradeep Sharma, Project Leaders]*

GENERATING LARGE SCALE ORDERED QUANTUM DOT ARRAYS, Feng Shi. The technique of self-assembly is considered as a less costly and simpler alternative to conventional nanostructure fabrication techniques. However, the thermodynamic driving forces for self-assembly are very small at the scale of nanometers, leading to the stacking of low energy defects that break the organization of the nanostructure arrays. In our work, we show that suitable "masking" of a deposition can be used to guide the creation of large scale ordered arrays. We model quantum dot growth using the competition between the crystal mismatch induced stress, the surface energy and the wetting interaction at the interface of the thin film and the substrate. The results from the numerical integration of our model show a significant improvement on the degree of perfection of quantum dot arrays produced by the application of the mask.

03:00 p.m. **Bing Lv** *[Prof. Arnold Guloy, Project Leader]*

SYNTHESIS, STRUCTURES AND PROPERTIES OF FeAs-BASED SUPERCONDUCTORS, Bing Lv. The synthesis and properties of AFe_2As_2 (A=K, Rb, Cs, K/Sr, and Cs/Sr) and AFeAs(A=Li, Na), a series of new type of Fe-based superconducting compounds, are reported. Alkali metal based KFe_2As_2, $RbFe_2As_2$, $CsFe_2As_2$ and LiFeAs, which do not need any additional doping to induce superconductivity and belong to a small family of intrinsic (self-doped) FeAs superconductors, are found superconducting at different temperatures. Superconductivity was induced in the spin density wave compound $SrFe_2As_2$ by doping with different K or Cs content and a complete phase diagram was obtained with peaks of T_c at 37K with 40-50% K substitution. The compounds represent p-type analogs of the n-doped rare-earth oxypnictide superconductors.

03:20 p.m. **Xiang Hu** *[Prof. Chin Sen Ting, Project Leader]*

QUASI-PARTICLE PROPERTIES IN IRON-BASED SUPERCONDUCTORS, Xiang Hu. The pairing symmetry is one of the major issues in the study of iron-based superconductors. We adopted a minimum two-band model, to introduce the two-band Bogoliubov de-Gennes equations. By solving those equations numerically, we checked the possibilities of different pairing symmetry, and calculated the local density of states for different cases. Our predictions can be tested by future experiments in spectrum tunneling microscopy.

03:40 p.m. **Lalithya C. Jayarathna** *[Prof. Rigoberto Advincula, Project Leader]*

ELECTRO-OPTICAL PROPERTIES OF LAYERED CdSe NANOPARTICLES AND 6TN (SEXITHIOPHENE BALAFORM AMPHIPHILES) NANOCOMPOSITES FOR DEVICE FABRICATION, Lalithya C. Jayarathna. Energy levels were designed for optimized Ionization potential (I_p) and electron affinity (E_a) of 6TN match with the valence and conduction bands of CdSe nanoparticles (NPs). This resulted in unique electrochemical and optical properties. The energy levels were used to investigate the effects of a charge transfer route on absorption and photoluminescence properties of hybrid thin films of CdSe NPs and 6TN. The films were fabricated via nanometer scale electrostatic layer-by-layer self-assembly. The thermodynamic cascade of separated charges in the heterojunction revealed the potential of such nanocomposites for photovoltaic cell devices.

04:00 p.m. ADJOURNMENT AND DELIBERATION OF JUDGES

04:20 p.m. ANNOUNCEMENT OF WINNERS; PHOTOS OF SPEAKERS, CHAIRS AND JUDGES
[Note: Please meet Sue Butler and Aby Shrivastava by the red wall in the HSC Lobby for photos]