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Cooperative International Science and Engineering Internships

Cooperative International Science and Engineering Internships(CISEI)
Summer 2006 - Student Projects

Student/School	Mentor	Faculty Sponsor	Site Abroad	Student Project
Samuel Beach UCSB, Electrical and Computer Engineering		Andrew Briggs	Materials Dept., Oxford University	Building an Electron Spin Resonance Microscopy Control System
David Bellotti UCSB, Computer Engineering		Yuri Rakovich	Semiconductor Photonics Group; Trinity College, Dublin, Ireland	Optically Switchable Emissions of CdTe Nanocrystals
Derek Brown UCSB, Chemical Engineering	Dr. Brett Helms	Dr. Bert Meijer	Technical University Eindhoven, Netherland	Investigation of Protein Modified Surfaces by Surface Plasmon Resonance
Jonathon Compton UCSB, Chemical Engineering	Dr. Ralf Schacherl	Prof. Dr. Ir. Eric Mittemeijer	Max Planck Institute, Stuttgart Germany	Nitriding of Iron Based Alloys
Renjayson Cunanan UCSB, pre-Biology	Dr. Brett Helms	Dr. Bert Meijer	Technical University Eindhoven, Netherlands	New Methods for Site-Specific Protein Immobilization on Surfaces
Nick Hallet UCSB, Mechanical Engineering		Prof. Luis Vargas	CIMAT, Mechanical Engineering	Development of the portable battery charger for the electric car
Lev Kurbanyan UCSB, Mechanical Engineering		J T Czernuszka	Materials Dept.; Oxford University	Mechanical Properties of Scaffolds with Channels Used for Tissue Engineering
Sarah Lansing UCSB, Mechanical Engineering		Brendan O'Neill	Silicon Fabrication Lab, Tyndall institute, Cork	Development of Planarisation Processes for Dielectrics and Metals

Shyam Natarajan UCSB, Computer Engineering and Japanese		Prof.Yong San Yoon	Dept. of Mechanical Engineering, KAIST	The Study about Ballistocardiogram Extraction and Detection of Sleep Posture and Periodic Limb Movements in Bed with Load Cells Located at Bottom of Bed Legs
Lisa val Verde UCSB, Mechanical Engineering		Prof. Werner Blau	Physics; Trinity College Dublin	Carbon nanotubes—a new generation of sensing materials
Karun Vijayraghavan UCSB, Electrical Engineering UCSB	Dr. Gunther Richter	Dr. Thomas Wuebben	Max Planck Institute in Stuttgart Materials Department	Microstructure Analysis and Mechanical Properties of bcc Thin Films

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Samuel's Project Page - CISEI summer 2006

Intern: Samuel Beach, UCSB
Mentor:
Faculty Supervisor: Andrew Briggs
Department: Materials Dept. Oxford University

Building an Electron Spin Resonance Microscopy Control System

Electron Spin Resonance Microscopy systems are complex pieces of equipment which use microwaves to investigate electron spins. Building a control system for an ESR requires being able to quickly send commands to microwave hardware, phase shifters, attenuation controllers, gauss field controllers, and the oscilloscope grabbing the results on the far side of the microwave cavity. A high-speed controller card designed by SpinCore was used to control the needed devices. The high-speed control card had libraries written in C so it was necessary to write drivers in C, to interface between the control card and the pulse programming environment. The programming environment had to be written in python, which was the preferred language that the experimental physicists wanted to work in, due to its easy readability and its forgiving syntax. The program I worked on I named PIPE or Pulse Interpreting Programming Environment due to its ability to turn a user's instructions into everything needed by the ESR system. I wrote the whole back end of the program, including the portion written to assemble the pulse train and all the necessary control signals from the pulse instruction language that I helped design. The language and program abstracted the actual pulse train and control signals by giving the users commands that could build entire pulses and would leave the gritty issues to the logic written into the back end of the program. At the end of my project, PIPE could be used to design a pulse sequence, run the sequence, and recover and analyze the results.

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David's Project Page - CISEI summer 2006

Intern: David Bellotti, UCSB, Computer Engineering
Mentor:
Faculty Supervisor: Yuri Rakovich
Site: Semiconductor Photonics Group; Trinity College, Dublin, Ireland

Optically Switchable Emissions of CdTe Nanocrystals

Studies have proved the ability for optically controlled switching systems involving nanocrystals and photochromics using fluorescence resonance energy transfer (FRET) properties. Yet the efficiency of these systems has not been explored and improved. When photochromics are irradiated with ultraviolet light, their structure changes and there is an induced absorption band at around for example 604.95nm for our spiropyran sample. At the same time a sample of CdTe nanocrystals 4.5nm in diameter are emitting photons at around 600nm. This overlap satisfies the FRET conditions. We found a degrading quality in the spiropyran which showed us that over a number of irradiations by UV light from a low-intensity lamp, there will no longer be a photo-induced absorption peak and the system will no longer work at all. We speculate that as the intensity of the UV light irradiations is increased, the speed of the degradation will also increase. Further exploration is necessary to improve efficiency and life-span of these systems.

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Derek's Project Page - CISEI summer 2006

Intern: Derek Brown, UCSB, Chemical Engineering
Mentor: Dr. Brett Helms
Faculty Supervisor: Dr. Bert Meijer
Site: Technical University Eindhoven, Netherlands

Investigation of Protein Modified Surfaces by Surface Plasmon Resonance

Strategies for the site-specific modification of surfaces with proteins and peptides were investigated. Cysteine functionalized surfaces were prepared using a novel approach involving several cysteine derivatives with different linkers to the surface. The effect of the linker on the ability of the cysteine to participate in protein/peptide immobilization via the native chemical ligation with C-terminal thioesters was explored using surface plasmon resonance.

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Jonathon's Project Page - CISEI summer 2006

Intern: Jonathon Compton, UCSB
Mentor: Dr. Ralf Schacherl
Faculty Supervisor: Prof. Dr. Ir. Eric Mittemeije
Site: Max Planck Institute, Stuttgart Germany

Nitriding of Iron Based Alloys

Nitriding is used in industry to reduce wear, and to strengthen metals. Theoretical research has been done to predict the patterns of chemical nitriding. Iron-aluminum alloy was used for one project to predict the nitrogen uptake with respect to time. For this, cross sections were measured with EPMA to determine the composition of the alloy. The results were then fitted to a mathematical model to try and predict how this alloy develops. The second project involved determining the absorption isotherms of ternary iron-aluminum-chromium alloys. These samples were nitrided at specific nitriding potentials, all at the same temperature, then de-nitrided, and weighed. The weight measurements were used in a mathematical model to predict the absorption isotherm of the specific alloy.

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Renjayson's Project Page - CISEI summer 2006

Intern: Renjayson Cunanan, UCSB, pre-Biology
Mentor: Dr. Brett Helms
Faculty Supervisor: Dr. Bert Meijer
Site: Technical University Eindhoven, Netherlands

New Methods for Site-Specific Protein Immobilization on Surfaces

A general strategy for the functionalization of dextran modified surfaces with proteins and peptides was developed. This project involved the preparation of cysteine deravitives for activating the surface towards C-terminal thioesters, using a process known as native chemical ligation. This allowed for the site-specific immobilization of bioactive peptides/proteins onto surfaces.

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Nick's Project Page - CISEI summer 2006

Intern: Nick Hallet, UCSB Mechanical Engineering
Mentor:
Faculty Supervisor: Prof. Luis Vargas
Site: CIMAT, Mechanical Engineering

Development of the portable battery charger for the electric car

Typically, electric cars use transformer power supplies to recharge their batteries. Though, due to the fact that the transformers required for such high power chargers are too big and heavy to install on the actual vehicle, these cars are limited to short urban journeys. Therefore, whenever an electric car needs to recharge its batteries, they must return to where their transformer is stationed. They do not have the capability or convenience of recharging at alternative locations. The only way to solve this problem is to design and build a "transformerless" battery charger (power switching converter) using an Isolated Gate Bipolar Transistor (IGBT) in tune with a microcontroller that frequently manages the duty cycle by reading current/voltage feedback from the output. An LC filter will be needed at the output, as well as a gate driver for the IGBT. The temperature of the circuit must also be kept as low as possible when in use, so as not to melt any of its components.

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Lev's Project Page - CISEI summer 2006

Intern: Lev Kurbanyan, UCSB
Mentor:
Faculty Supervisor: J T Czernuszka
Site: Materials Dept.; Oxford University

Mechanical Properties of Scaffolds with Channels Used for Tissue Engineering

Tissue engineering is a rapidly expanding commercial and research area. Currently, skin and articular cartilage tissue have been engineered and are available for clinical use. However, other larger structures have been more difficult to produce. The major reason for this is the diffusion constraints imposed on the scaffold. A novel and unique method for producing three dimensional scaffolds is proposed though solid freeform fabrication which allows for the creation of microvasculature within the scaffold ensuring that nutrients are kept supplied to cells deep within the structure. The mechanical properties of the scaffolds with the microvasculature was investigated and compared to traditional scaffolds.

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Sarah's Project Page - CISEI summer 2006

Intern: Sarah Lansing, UCSB
Mentor:
Faculty Supervisor: Brendan O'Neill
Site: Silicon Fabrication Lab.; Tyndall Inst. Cork

Development of Planarisation Processes for Dielectrics and Metals

The intent of this project was to develop and integrate a planarisation process for silicon device wafers. This included determining an ideal set of process parameters for the chemical-mechanical polishing (CMP) machine, as well as finding procedures to keep the wafers clean and machine running at high precision. The four stages of this project included polishing un-patterned PECVD oxide ILD wafers; polishing the PECVD Oxide ILD layer on patterned metal wafers; refining a short-loop process integrating the CMP process with two metal layers; and finally, integrating the CMP process for the ILD layer into the full CMOS flow. These trials were accomplished by running tests on the CMP machine and inspecting the results with the nanospec, microscope, and the SEM. The various process parameters were adjusted accordingly until the optimum settings were determined. We have achieved a CMP polish process that leaves a patterned device wafer smooth and clean enough for further layers of metal deposition. A set of general parameters have been adapted and refined to suit the typical wafers that pass through this fabrication facility. This process is ready to be integrated into Tyndall's fabrication flow, which will enable the facility to output more complex device wafers.

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Shyam's Project Page - CISEI summer 2006

Intern: Shyam Natarajan, UCSB
Mentor:
Faculty Supervisor: Prof.Yong San Yoon
Site: Dept. of Mechanical Engineering, KAIST

The Study about Ballistocardiogram Extraction and Detection of Sleep Posture and Periodic Limb Movements in Bed with Load Cells Located at Bottom of Bed Legs

A ballistocardiogram (BCG) is a tool used to measure the mechanical forces within the heart. Traditionally the electrocardiogram (EKG/ ECG) is used to extract a heart-produced signal. However, the advantage of using a BCG is its unobtrusive nature, as only a slightly modified bed or chair is required in data capture. The problems that arise with the BCG is due to poor filtering and inconsistency in signals measured in different positions. During the course of the project, a variety of filtering techniques were evaluated and tested in order to improve the quality of the BCG signal. Several algorithms were also implemented in order to detect peaks in the signal. Finally, a novel method to improve peak detection was founded, This method was also used to detect the posture of the subject from which the signal was extracted .

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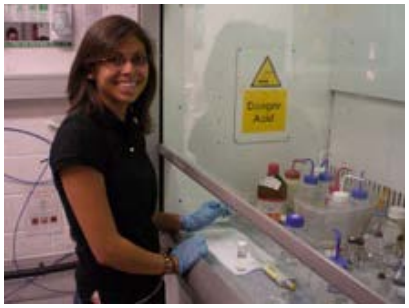
Lisa's Project Page - CISEI summer 2006



Intern: Lisa val Verde, UCSB, Mechanical Engineering
Mentor:
Faculty Supervisor: Prof. Werner Blau
Site: Trinity College Dublin, Ireland

Carbon nanotubes—a new generation of sensing materials

In the realm of Nanotechnology, Carbon Nanotubes are of high research interest due to their unique physical properties. These properties suggest carbon nanotubes (CNT) may offer an exciting opportunity for both lattice modification to induce specificity and improved electrical transduction. These two properties form the basis for the development of enhanced sensing systems, which are of high interest in research since modification of nanoscale materials has created increasing interest in novel hybrids for applications such as electronic platforms in molecular devices, particularly as sensors. The implementation of carbon nanotubes as electrical transducers is thought to lead to a new generation of solid-state, conventional chemical or bio-sensors. Previous research conducted with the combination of the porphyrin tetraphenylporphryin (TPP) and single-walled nanotubes (SWNT) dispersed in chloroform suggested sensitivity to acids. In this study TPP and SWNT were dispersed in Dimethylflormide (DMF) and were later titrated with the following acids: Citric Acid, Ascorbic Acid, Acetic Acid, Hydrochloric Acid, and TFA. Surprisingly, the results suggested that the presence of carbon nanotubes did not dramatically increase the sensitivity to acids as the study with Chloroform suggested. This proposes the idea that the nanotubes may react well with chlorinated solvents. Further studies are needed to confirm results.

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Karun's Project Page - CISEI summer 2006

Intern: Karun Vijayraghavan, UCSB
Mentor: Dr. Gunther Richter
Faculty Supervisor: Dr. Thomas Wuebben
Site: Max Planck Institute in Stuttgart Materials Department

Microstructure analysis and mechanical properties of bcc thin films

Due to their wide use in applications, the mechanical properties of fcc-structured thin films have been well studied, with results showing a films flow stress as being inversely related to its thickness – a relationship known as the size effect. On the other hand, the mechanical properties of bcc thin films is a novel subject and it is unknown if they have an observable size effect. In this study, we are interested in growing bcc iron thin films on a compliant substrate necessary for conducting tensile tests - a method that could shed light on the size effect in bcc thin films. The microstructure of the films grown had to have grains significantly larger than the films thickness (nearly single crystalline properties), a smooth surface, as well as texture. The films were deposited in ultra high vacuum conditions via Molecular Beam Epitaxy. Surface characterization techniques, XPS, AES, and RHEED measurements were taken to ensure that the films were of high quality. Focused ion beam and scanning electron microscopy were used to determine whether or not the microstructure of the films were suitable for conducting tensile tests. The results of our work show that by using a new growth mode, dubbed the “Two Step Process”, we are able to grow films with the required microstructure necessary for conducting tensile tests.

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