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Cooperative International Science and Engineering Internships

Cooperative International Science and Engineering Internships(CISEI)
Summer 2007 - Student Projects

Student / School	Mentor	Faculty Sponsor	Site Abroad	Student Project
Andrea Bayles UCSB, CCS Chemistry & Biochemistry	Dr. Brett Helms, ir. Edith Lempens	Prof. Dr. E.W. (Bert) Meijer	Department of Macromolecular and Organic Chemistry, Technical University Eindhoven, Netherlands	Synthesis of Multivalent Constructs for Biological Applications
Shannon Beaty UCSB, Biology and Spanish	Leonardo Enrique Sáenz Iturriaga	Professor José Luís Arias	CIMAT, Santiago, Chile	The Importance of Dermatan Sulfate to the Deposition of $CaCO_3$ in Chicken Eggshells
Renjayson Cunanan UCSB, Pharmacology	Fengli Hu	Xiangmin Zhang	Department of Chemistry, Fudan University China	Enzyme Inhibitor Screening by High Performance Liquid Chromatography with a Novel Immobilized Enzyme Method Using Magnetic Nanospheres
Joy Dai UCSB, Biochemistry	Drs. Brett Helms and Edith Lempens	Prof. E. W. (Bert) Meijers	Department of Macromolecular and Organic Chemistry, Technical University Eindhoven, Netherlands	Oxime Ligation on Biacore Chip
Shelley A. Esakoff UCSB, Chemical Engineering	Yunyi Wong	Gao Qing (Max) Lu	ARC Centre for Functional Nanomaterials, The University of Queensland, St. Lucia in Brisbane, QLD Australia	siRNA Delivery via Layered Double Hydroxides
Elina Glaretas UCSB, Chemical Engineering	Dr. Cristian Covarrubias	Prof. Dr. Raul Quijada	Center for Advanced Interdisciplinary Research in Materials (CIMAT)	Polyethylene Polymerization with SBA-15 Support

Gabriel Martinez UCSB, MCDB		Adriele Prina-Mello, J.M.D. Coey	CRANN & SFI Nanoscience Laboratory, Trinity College Dublin, Dublin, Ireland	Mechanical Properties of Scaffolds with Channels Used for Tissue Engineering
Kathryn McGill UCSB, Physics		Prof. Andrew Watt	Dept of Materials, Oxford University, England	Principles of Organic Photovoltaic Impedance Analysis
Vy Nguyen UCSB, Biochemistry and Chemistry	Fengli Hu	Xiangmin Zhang	Dept of Chemistry, Fudan University, China	Microwave-Assisted Extraction for the Determination of Chlorogenic Acid in Honeysuckle
Brian Rich UCSB, Chemistry		Dr. Jan Czernuska	Department: Department of Materials, Oxford University, England	Drug Delivery via Hydroxylapatite Coated Microspheres
Kyle Stewart UCSB, Electrical Engineering	Iris Choi & Alan Riordan	Rod Webb	Photonics Systems Group, Tyndall National Institute, Cork, Ireland	Tests for Sensitivity of Submarine Cables to Seismic Disturbances

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Bayles' Project Page - CISEI summer 2007

Intern: Andrea Bayles, UCSB, Chemistry
Mentor: Dr. Brett Helms, ir. Edith Lempens
Faculty Supervisor: Prof. Dr. E.W. (Bert) Meijer
Department of Macromolecular and Organic Chemistry, Technical University Eindhoven, Netherlands

Synthesis of Multivalent Constructs for Biological Applications

The synthesis of multivalent protein and peptide constructs for interfacing with biological systems was investigated. A series of dendritic polymers functionalized with immunolabels or fluorescent dyes were coupled to proteinogenic molecules of biological interest via native chemical ligation. These multivalent constructs are uniquely poised for quantifying the binding of various multivalent protein-protein and protein-peptide interactions in chemical biology.

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Beaty's' Project Page - CISEI summer 2007

Intern: Shannon Beaty, UCSB, Biology and Spanish
Mentor:
Faculty Supervisor: Leonardo Enrique Sáenz Iturriaga and Professor José Luís Arias
CIMAT, Santiago, Chile

The Importance of Dermatan Sulfate to the Deposition of $CaCO_3$ in Chicken Eggshells

The avian eggshell is a calcified acellular composite whose inorganic part is formed in conjunction with the organic in sequence during the 22 hours in which the egg travels along the oviduct. A proteoglycan called ovoglycan forms the organic part of the shell, and is found in the epithelial cells of the red ithmus and the shell gland regions within the oviduct. This molecule is composed of a base protein called ovocleidin 116, to which chains of the sugar dermatan sulfate are attached. The principal objective of my research is to identify the role of the sugar dermatan sulfate in the deposition of calcium carbonate during the formation of the chicken eggshell. The necessity of dermatan sulfate in this process will be evaluated through the fabrication of the protein ovocleidin 116 without its associated sugars and testing its capacity to catalyze calcium deposition in vitro.

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Cunanan's' Project Page - CISEI summer 2007

Intern: Renjayson Cunanan, UCSB, Pharmacology
Mentor: Fengli Hu
Faculty Supervisor: Xiangmim Zhang
Department of Chemistry, Fudan University China

Enzyme Inhibitor Screening by High Performance Liquid Chromatography with a Novel Immobilized Enzyme Method Using Magnetic Nanospheres

A novel immobilized enzyme strategy created by magnetic nanospheres for monitoring enzyme activity and screening inhibitors followed by high performance liquid chromatography has been demonstrated. Through the reaction of the aldehyde groups with amine groups, a-glucosidase was simply and stably immobilized onto magnetic nanospheres by the cross linking agent glutaraldehyde. A baseline profile of enzyme activity was determined by incubating a solution of the natural substrate with the immobilized enzyme for 30 min prior to analysis of the product distribution of the supernatant by HPLC. Enzyme inhibition by three candidate Traditional Chinese Medicines (TCMs) was then investigated using a similar methodology, spiking the substrate solutions with the suspected or known inhibitors. This assay was able to readily quantify the reduction of the immobilized enzyme activity based on the reduced peak area of the product relative to an internal standard. This approach is general and offers many attractive advantages including easy product isolation, inexpensive cost, and high efficiency in terms of reagent consumption.

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Dai's' Project Page - CISEI summer 2007

Intern: Joy Dai, UCSB, Biochemistry
Mentor: Drs. Brett Helms and Edith Lempens
Faculty Supervisor: Prof. E. W. (Bert) Meijers
Department of Macromolecular and Organic Chemistry, Technical University Eindhoven, Netherlands

Oxime Ligation on Biacore Chip

Site specific protein immobilization onto surfaces for biosensors is highly desirable for achieving reproducible kinetic and thermodynamic analysis of biomolecular interactions with various analytes of interest. We have, in previous projects, successfully done so at the C-terminus of proteins using native chemical ligation. The current thrust was aimed at protein immobilization through the N-terminus. Three approaches - synthetic, semisynthetic, and genetic - were identified for the required protein derivititization to enable site-specific anchoring to the surface. The first two of these schemes was carried out this summer with great success, ongoing experiments have indicated unprecedented rates of immobilization to surfaces using various aqueous soluble organocatalysts.

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Esakoff's' Project Page - CISEI summer 2007

Intern: Shelley A. Esakoff, UCSB, Chemical Engineering
Mentor: Yunyi Wong
Faculty Supervisor: Gao Qing (Max) Lu
ARC Centre for Functional Nanomaterials, The University of Queensland, St. Lucia in Brisbane, QLD Australia

siRNA Delivery via Layered Double Hydroxides

Delivery of genomic material into the cell has many advantages including advances in gene therapy and biochemical research. A new transfection method via layered double hydroxides transfects cells by receptor mediated-endocytosis and the genomic material is released by the acidity of the endosome. Layered double hydroxides (LDHs) offer a reservoir for various anionic guests including inorganic anions, organic acids, and nucleic acids. LDH hallow spheres are also of interest because they might be easier for cells to uptake due to its high surface area and defined space. Preliminary results show that the synthesis for making LDH hallow spheres needs to be optimized. Fluorescein isothiocyanate (FITC) is incorporated into the LDH structure first used to determine the optimum conditions by kinetic changes. UV/Vis is used to determine how much FITC is incorporated into the LDH structure. Using X-ray diffraction, the molecules which sit in the LDH structure are identified by d-spacing. The stability of the LDH materials is determined by zeta potential. A simple non-viral gene vector is synthesized by using LDH as a reservoir for nucleic acids and has been successful in gene delivery.

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Glaretas's' Project Page - CISEI summer 2007

Intern: Elina Glaretas, UCSB, Chemical Engineering
Mentor: Dr. Cristian Covarrubias
Faculty Supervisor: Dr. Raul Quijada
Center for Advanced Interdisciplinary Research in Materials (CIMAT) and Department of Chemical Engineering, La Universidad de Chile, Santiago, Chile

Polyethylene Polymerization with SBA-15 Support

Metallocene catalyzed polymerization is carried out traditionally by using amorphous mesoporous silica as support. However in the last decade, novel mesoporous silica based material has been developed. SBA-15 is a silica material characterized by its highly ordered tubular mesoporous channels (60-120 Å), and by its high specific surface area (>500 m^2/g). Considering these special structural properties of SBA-15, this material was used as metallocene catalyst support in order to improve the catalytic efficiency of the metallocene catalytic system. SBA-15 was synthesized by a surfactant self-assembly process. Metallocene SBA-15 supported catalysts were evaluated in heterogeneous ethylene polymerization process. Detailed material characterization was performed by using X-ray diffraction, N2 absorption analysis, DRIFT spectroscopy, and DSC calorimetry. The SBA-15 supported metallocene catalyst exhibited high catalytic activity for ethylene polymerization as compared with a traditional amorphous commercial support (Witco). The high performance of the SBA-15 catalyst system can be explained by the ordered structure, large pore opening, and high surface area of the SBA-15 material. SBA-15 appears as promissory material to be used as metallocene support for ethylene polymerization process.

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Martinez's' Project Page - CISEI summer 2007

Intern: Gabriel Martinez, UCSB, MCDB
Mentor:
Faculty Supervisor: Adriele Prina-Mello, J.M.D. Coey
CRANN & SFI Nanoscience Laboratory, Trinity College Dublin, Dublin, Ireland

Morphological and Transcriptional Responses in MC-3T3 Osteoblast-like cells by Exposure to Extremely Low-Frequency Electromagnetic Fields

There have been many studies on both morphological and biochemical effects of Extremely Low-Frequency Electromagnetic Fields (ELF-EMF) and their potential use for treatment of bone injuries and disorders. Still, many of them have resulted inconclusive or irreproducible because of missing information such as variables in magnetic flux, induced electric fields, and incubation systems. In this study, we have developed a setup in which we address both the morphologic and biochemical effects of the ELF-EMF using similar exposure systems as found in literature. We prepared the murine pre-osteoblast cell line MC-3T3-E1 for exposure to ELF-EMF radiation in a copper wire solenoid for 12, 24, 48, or 72 hours at 50 Hz and 2mT vPP. To study cell cytoskeletal morphology and the expression of the differentiation factor cbfa1, cells were stained with fluorescent dyes. The transcription levels of two other differentiation markers, collagen type I and alkaline phosphatase were observed using the Real-time RT-PCR method. From the results here presented are rearrangements of the actin cytoskeletal structures as well as an up-regulation of cbfa1 in exposed cell systems. Real-Time PCR results are currently under analysis and will determine changes in transcriptional levels of these differentiation markers. We propose that ELF-EMF are responsible for these morphological and transcriptional changes.

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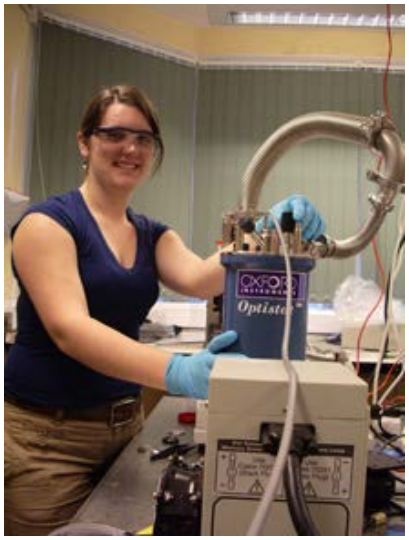
McGill's' Project Page - CISEI summer 2007



Intern: Kathryn McGill, UCSB, Physics
Mentor:
Faculty Supervisor: Prof. Andrew Watt
Dept of Materials, Oxford University, England

Principles of Organic Photovoltaic Impedance Analysis

Organic photovoltaic cells – plastic solar cells – have the potential to become cheap alternatives to expensive silicon solar cells. However, at present, device efficiency is not high enough for them to be commercially viable. Understanding the physics of charge transport within the cells is an important step towards improving the power conversion efficiencies of photovoltaic devices. In this project we use impedance spectroscopy to study the charge transport dynamics in a bulk heterojunction photovoltaic cell. Impedance spectroscopy is a useful tool for investigating device physics as it is particularly sensitive to processes that occur at material interfaces. While the technique has been widely applied to electrochemical cells, it is virtually absent from the study of organic photovoltaics. By first understanding electrochemical models for impedance, we hypothesize and test organic photovoltaic transport mechanisms with the ultimate goal of feeding back knowledge to enhance device processing.

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Nguyen's' Project Page - CISEI summer 2007

Intern: Vy Nguyen, UCSB, Biochemistry and Chemistry
Mentor: Fengli Hu
Faculty Supervisor: Xiangmin Zhang
Dept of Chemistry, Fudan University, China

Microwave-Assisted Extraction for the Determination of Chlorogenic Acid in Honeysuckle

Microwave-assisted extraction (MAE) and high performance liquid chromatography (HPLC) coupled with mass spectroscopy was used to determine that chlorogenic acid (CA) was the active component for Honeysuckle, an herb in traditional Chinese medicine. Three methods for solid-liquid extraction were tested, and MAE proved to be the most effective. The traditional method of reflux extraction (RE) was tedious, time consuming, and required large amounts of solvents. The other method of ultrasonic extraction (USE) was used for CA extraction, but it did not show satisfactory efficiency and was not suitable for quantification analysis. MAE was not only more efficient compared to the other two traditional heating extractions. This is because MAE internally heats the sample based on conduction and dielectric polarization caused by microwave irradiation. MAE was the most efficient method in the extraction of CA from Honeysuckle because of the considerable savings in processing time (4 min), accuracy, and less solvent consumption. When using MAE, sixteen components were detected in the extract of Honeysuckle compared to the eight and nine components in RE and USE, respectively. An HPLC machine was used to analyze the extract with CA being the highest peak.

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Rich's' Project Page - CISEI summer 2007

Intern: Brian Rich, UCSB, Chemistry
Mentor:
Faculty Supervisor: Dr. Jan Czernuska
Department: Department of Materials, Oxford University

Drug Delivery via Hydroxylapatite Coated Microspheres

Description: A technique was developed to incorporate drugs into concentrated packets in microspheres with directionality and a controlled release profile. The technique involves control at multiple levels of hierarchy. The drugs can be incorporated either within the liposomes or be attached to the outer surface. The outside of each liposome is coated with physiologically similar hydroxyapatite of a controlled size and stoichiometry.These assemblies are then processed to create precise and predetermined macroporosity on a scale suitable for cellular penetration.The assemblies were characterised and their drug release profiles determined.

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Stewart's' Project Page - CISEI summer 2007

Intern: Kyle Stewart, UCSB, Electrical Engineering
Mentor: Iris Choi & Alan Riordan
Faculty Supervisor: Rod Webb
Photonics Systems Group, Tyndall National Institute, Cork, Ireland

Tests for Sensitivity of Submarine Cables to Seismic Disturbances

Large areas of the globe are not currently monitored for seismic data, so that small but scientifically valuable activity is not recorded. One possibility to remedy this is through monitoring changes in polarization state for the light being carried in the transoceanic fiber optic cables. Changes in the bends or stresses of a cable from seismic activity induce birefringence, which induces an observable change in polarization state. Such a system would enable the monitoring of large stretches of the ocean floors where there currently are few or no sensors. This additional information would likely be extremely useful for scientists studying seismic behavior to gain further insight and possibly even improve warning times for earthquakes or tsunamis.

To test the viability of such a system, several tests were conducted in the laboratory and the real world. A series of static tests involving a birefringent loop showed that although there is deviation from the output predicted by Jones Calculus, bending a fiber does create a marked change in polarization. Next, several dynamic test simulated an earthquake and found close correlation with the monitored polarization state, and established a linear relationship between the displacement of a fiber and the change in polarization for small amplitude movements. Finally, a series of real world tests on a buried fiber showed a number of distinct vibrational events, but there can be no current certainty as to the source. Therefore, this system is not proven but the evidence suggests a high possibility of it being feasible.

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