Education

Undergraduate Opportunities
K-12 Science Activities
For Teachers
Education Contacts
News

Research Internships in Science and Engineering

Research Interns in Science and Engineering (RISE)
Summer 2007 - Student Projects

Student Major/School	Mentor	Faculty Sponsor	Department	Student Project
Nick Anderson Biological Sciences Univ of Washington	Nick Strandwitz	Galen Stucky	Materials	QUANTUM DOT SENSITIZED PHOTOVOLTAIC DEVICES
Shemekia Braddock Chemistry Jackson State University	Brent Melot	Ram Seshadri	Materials	BOND LENGTH AND BOND DISTORTION OF FERROELECTRIC $BATIO_3$
Jonathan Compton Biochemistry UC Santa Barbara	Andy Pascall	Todd Squires	Chemical Engineering	SYNTHESIS OF JANUS PARTICLES USING FLOW FOCUSING IN MICROFLUIDIC DEVICES
Robin Cumming Chemistry Mills College	Travers Anderson	Jacob Israelachvili	Chemical Engineering	UNDERSTANDING VESICLE FUSION: INTERACTIONS BETWEEN SUPPORTED BILAYERS AND SOLID SUBSTRATES
Kari Darling Chemistry Lake Superior State University	Alex Ostrowski	Peter Ford	Chemistry and Biochemistry	PHOTOSENSITIZED RELEASE OF NITRIC OXIDE USING QUANTUM DOTS
Lara Deek Computer and Communications Science American University of Beirut	Khaled Harras	Kevin Almeroth	Computer Science	MOBILITY MODEL PREDICTION AND ADAPTATION
Jennifer Drewes Chemistry UC Santa Barbara	Daniel Shoemaker	Ram Seshadri	Materials	SPONTANEOUS FORMATION OF METAL OXIDE MAGNETIC NANOPARTICLE COMPOSITES

Tim Dunn Chemistry Cal State Chico	Bridget Owens	Peter Ford	Chemistry and Biochemistry	PHOTOINDUCED LINKAGE ISOMERIZATION OF RU(SALEN)(ONO)(NO)
Bobola Famuyibo Electrical Engineering UC Santa Barbara	Anurag Tyagi, Barry Zhong and Roy Chung	Shuji Nakamura	Materials	CHARACTERIZATION AND OPTIMIZATION OF P-TYPE GALLIUM NITRIDE
Brittny Glasper Chemistry Jackson State University	Karen Dane	Patrick Daugherty	Chemical Engineering	TARGETING CANCER CELLS USING BACTERIA
William Hardy Chemistry Jackson State University	Luis Campos	Craig Hawker	Materials	SYNTHESIS OF SILICA/POLYMER NANOPARTICLES FOR BIOASSAYS
Thomas Huang Physics Grinnell College	Youli Li	Youli Li	Materials	COMPUTER SIMULATION OF X-RAY PROPAGATION IN SAXS FACILITIES
Matt Lavelle Chemical Engineering Univ. of Michigan	Guohui Wu	Joseph Zasadzinski	Chemical Engineering	VESOSOME SIZE REDUCTION FOR USE AS A DRUG DELIVERY VESICLE
Ellis Robinson Chemical Engineering Ohio State University	Ryan Snyder	Michael Doherty	Chemical Engineering	CRYSTAL SHAPE PREDICTION – A SENSITIVITY ANALYSIS OF THE SPIRAL DISLOCATION MECHANISM MODEL
Jake Vestal Chemical Engineering North Carolina State	Patrick Stenger	Joseph Zasadzinski	Chemical Engineering	A SYNTHETIC LUNG SURFACTANT FOR TREATMENT OF RESPIRATORY DISTRESS SYNDROME
Karun Vijayraghavan Electrical Engineering UC Santa Barbara	Natalie Fellows	Steven Denbaars	Materials	PACKAGING OF BLUE PUMPED-YELLOW PHOSPHOR LIGHT EMITTING DIODES
Joshua Walker				CMAS- A NEW CHALLENGE FOR

Chemistry Jackson State University	Stephan Kramer	Carlos Levi	Materials	THERMAL BARRIER COATINGS IN ADVANCED JET TURBINE ENGINES

Return to the RISE homepage

Nick's Project Page - RISE Summer 2007

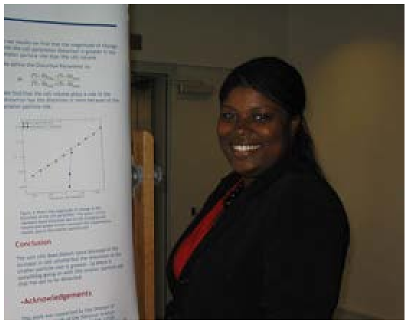
Intern: Nick Anderson, Biological Sciences, University of Washington
Mentor: Nick Strandwitz
Faculty Supervisor: Galen Stuckey
Department: Materials

QUANTUM DOT SENSITIZED PHOTOVOLTAIC DEVICES

Current photovoltaics are manufactured through energy intensive processes and are therefore expensive. Quantum dot sensitization of nanoscopic metal oxide semiconductors is a promising inexpensive alternative to silicon-based semiconductors. Quantum dots (QDs) are semiconductor nanoparticles, which exhibit quantized electronic energy levels due to their nanoscopic size. The size of the particle determines its optical absorption properties, thus allowing for tunable energy levels and absorption in the visible spectrum. These particles can then incorporated into the nano-pores of semiconducting metal oxide films to induce photocurrents by sensitizing (via electron donation) the metal oxides to a wider range of the spectrum. A number of different variables were tested to create the most efficient devices utilizing this concept. Cadmium sulfide QDs were compared with lead sulfide QDs on various metal oxides, including TiO2, SnO2, and ZnO. Two methods were employed to sensitize the semiconductors; the SILAR technique and attachment of pre-synthesized QDs. Various redox electrolytes were also tested, including non-aqueous cobalt complexes, used previously in dye-sensitized solar cells, and aqueous sodium sulfide. These redox couples were selected because they show little photo- corrosion towards the QDs. Sandwich-cell devices were tested with focused light from a mercury lamp, and photocurrents and photovoltages were observed. Cadmium sulfide on TiO2 with a 2M sodium sulfide redox electrolyte doped with elemental sulfur and sodium hydroxide produced the most photocurrent. The cobalt complexes do not show any dark chemistry, and therefore may be better suited as redox electrolytes for QD sensitized photovoltaic devices.

Return to the RISE 2007 project list

Shemekia's Project Page - RISE Summer 2007



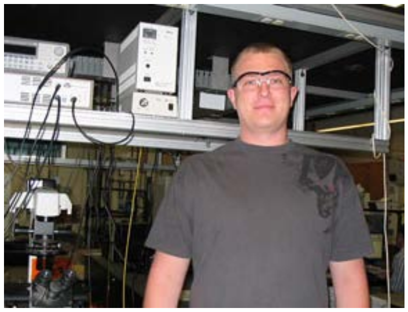
Intern: Shemekia Braddock, Chemistry, Jackson State University
Mentor: Brent Melot
Faculty Supervisor: Ram Seshadri
Department: Materials

BOND LENGTH AND BOND DISTORTION OF FERROELECTRIC $BATIO_3$

$BaTiO_3$ is a ferroelectric oxide that exhibits a phase change from tetragonal to cubic at 130°C. In the tetragonal structure of $BaTiO_3$ the apical Ti-O bonds are longer than the equatorial bonds. In the cubic structure the titanium is centered octahedrally surrounded by six oxygen atoms, with all bond lengths being equal. Recent experiments have shown that as particle size get smaller bond distortion increases, i.e. one Ti-O apical bond increases while the other Ti-O apical bond decreases. Experiments also suggest that this distortion is because the size of the unit cell volume increases with smaller particle size, and the Ti atoms have more freedom to move off center. With the research presented, we determined if the cell volume is the primary contributing factor to bond distortion exhibited in smaller particle size. Density Functional Theory calculations were used to look at these factors using Quantum Espresso. A relaxation was done to test different cell volumes to get the short and long bond lengths for each value. The results show that the cell volume does cause the unit cell bond lengths to distort but the smaller particle size causes a greater distortion.

Return to the RISE 2007 project list

Jonathan's Project Page - RISE Summer 2007



Intern: Jonathan Compton, Biochemistry, UC Santa Barbara
Mentor: Andy Pascall
Faculty Supervisor: Todd Squires
Department: Chemical Engineering

SYNTHESIS OF JANUS PARTICLES USING FLOW FOCUSING IN MICROFLUIDIC DEVICES

By co-flowing two dissimilar polymers through a microfluidic device using a flow focusing geometry Janus particles are created. These particles can be widely used because they have a controlled functionality. They can be used in applications from microelectronics, electronic paper or display technology, to drug delivery, where two forms of medicine can be delivered simultaneously. Soft lithography is used for the creation of PDMS micro devices. The techniques involved in simple drop formation and Janus drop formation are the focus of this project.

Return to the RISE 2007 project list

Robin's Project Page - RISE Summer 2007

Intern: Robin Cumming, Chemistry, Mills College
Mentor: Travers Anderson
Faculty Supervisor: Jacob Israelachvili
Department: Chemical Engineering

UNDERSTANDING VESICLE FUSION: INTERACTIONS BETWEEN SUPPORTED BILAYERS AND SOLID SUBSTRATES

Abstract pending faculty approval.

Return to the RISE 2007 project list

Kari's Project Page - RISE Summer 2007

Intern: Kari Darling, Chemistry, Lake Superior State University
Mentor: Alex Ostrowski
Faculty Supervisor: Peter Ford
Department: Chemistry and Biochemistry

PHOTOSENSITIZED RELEASE OF NITRIC OXIDE USING QUANTUM DOTS

Due to its vast biological importance, nitric oxide (NO) research has been of major concern in the scientific community over the past two decades. The physiological roles of nitric oxide are varied and include its function as a biological signaler in vasodilatation, immune response, and its role as a neurotransmitter. Because it is a free radical, NO treatment has applications as a possible enhancement for radiation therapy. A major interest in this field of NO research concerns methods of delivery to a specific tissue in a body. The photochemical release of nitric oxide is being explored as a method to control both location and timing of nitric oxide release. This project deals specifically with photochemical release of NO from a dinitrito polyamine chromium complex, and attempts to maximize its biological applications using nanoparticle semiconductor quantum dots as antennas for the photochemical reaction. Quantum dots are used for this photochemical enhancement due to their high absorption, tunable optical properties, and promising potential as energy donors. While energy transfer between quantum dots and the dinitrito polyamine chromium complex was observed in solution, covalent coupling between complex and quantum dots is desired for biological applications. The focus of this research was synthesis of a dinitrito polyamine chromium complex with an added carboxylic acid functionality, to be later coupled to a modified surface of a quantum dot.

Return to the RISE 2007 project list

Lara's Project Page - RISE Summer 2007

Intern: Lara Deek, Computer and Communications Engineering, American University of Beirut
Mentor: Khaled Harras
Faculty Supervisor: Keven Almeroth
Department: Computer Science

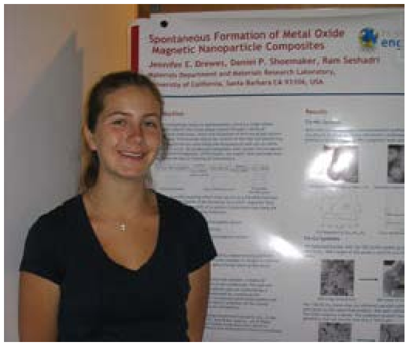
MOBILITY MODEL PREDICTION AND ADAPTATION

Abstract pending approval by faculty

Return to the RISE 2007 project list

MATERIALS RESEARCH LABORATORY at UCSB: an NSF MRSEC
the innovation engine for new materials

Jennifer's Project Page - RISE Summer 2007



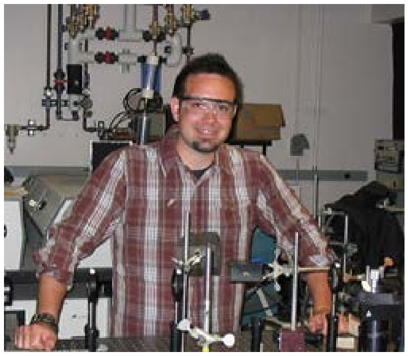
Intern: Jennifer Drewes, Chemistry, UC Santa Barbara
Mentor: Daniel Shoemaker
Faculty Supervisor: Ram Seshadri
Department: Materials

SPONTANEOUS FORMATION OF METAL OXIDE MAGNETIC NANOPARTICLE COMPOSITES

We are investigating routes to spontaneously convert a single phase metal oxide system into a two phase system through a series of oxidations and reductions. Since the formation of the two-phase system is spontaneous, this process allows for control of the size and patterning of the nanoparticles by controlling the temperature and rate at which the reactions occur. By producing composites that contain ferromagnetic (FM) and antiferromagnetic (AFM) phases, we expect that exchange bias will be observed due to interfacial interactions. Exchange bias is the coupling effect that occurs at a FM-AFM interface when the system is cooled in the presence of a static magnetic field. Exchange bias results in a shift of a system’s hysteresis loop along the field axis, usually in the negative direction. We have characterized composites and ternary oxides solid solutions of Cr, Mn, Fe, Co, and Ni using x-ray diffraction, Rietveld refinement, thermogravimetric analysis, and scanning electron microscopy.

Return to the RISE 2007 project list

Tim's Project Page - RISE Summer 2007



Intern: Tim Dunn, Chemistry, Cal State Chico
Mentor: Bridget Owens
Faculty Supervisor: Peter Ford
Department: Chemistry and Biochemistry

PHOTOINDUCED LINKAGE ISOMERIZATION OF RU(SALEN)(ONO)(NO)

Research in fundamental photochemical reactions related to nitric oxide and nitrite helps further the understanding of the reactivity of these biologically important molecules. This research describes the synthesis, characterization, and photochemistry of Ru(salen)(ONO)(NO). FTIR spectroscopy is currently being used to study the photochemical loss of NO and the possible photoinduced linkage isomerization of the O-bound nitrito ligand (-ONO) producing an N-bound nitrite species (-NO_2). Studies regarding this isomerization provides insight into the fundamental interactions between ruthenium and NO_x species.

Return to the RISE 2007 project list

Education

Undergraduate Opportunities
K-12 Science Activities
For Teachers
Education Contacts
News

Bobola's Project Page - RISE Summer 2007

Intern: Bobola Famuyibo, Electrical Engineering, UC Santa Barbara
Mentor: Anurag Tyagi, Barry Zhong, Roy Chung
Faculty Supervisor: Shuji Nakamura
Department: Materials

CHARACTERIZATION AND OPTIMIZATION OF P-TYPE GALLIUM NITRIDE

Abstract pending faculty approval

Return to the RISE 2007 project list

Brittny's Project Page - RISE Summer 2007

Intern: Brittny Glasper, Chemistry, Jackson State University
Mentor: Karen Dane
Faculty Supervisor: Patrick Daugherty
Department: Chemical Engineering

TARGETING CANCER CELLS USING BACTERIA

Identifying cancer cell-specific binding molecules should greatly improve cancer treatment therapies since many current methods are non-specific, attacking target as well as normal cells. Peptides are an attractive targeting ligand since they are naturally occurring, can be easily produced, and can be tailored to become cancer cell-specific. By modifying an outer membrane protein (Omp A) of the bacterium E. coli to contain random peptides on its surface, selections were performed to isolate peptides that allowed for binding to tumor cells. In addition to OmpA, the bacteria were engineered to express a green fluorescent protein (GFP) that was used as a marker to indicate if bacteria were binding to the tumor cells. These tumor-binding bacteria were isolated and characterized using Fluorescence Activated Cell Sorting (FACS), and the DNA of the bacteria was sequenced to determine the identity of the targeting peptide. Three bacterial clones expressing peptides sequences known to bind breast tumor cells were assayed for their ability to also internalize into the cells. Finding such peptides will benefit cancer research greatly by allowing for more specific, targeted therapies.

Return to the RISE 2007 project list

Education

Undergraduate Opportunities
K-12 Science Activities
For Teachers
Education Contacts
News

William's Project Page - RISE Summer 2007

Intern: William Hardy, Chemistry, Jackson State University
Mentor: Luis Campos
Faculty Supervisor: Craig Hawker
Department: Materials

SYNTHESIS OF SILICA/POLYMER NANOPARTICLES FOR BIOASSAYS

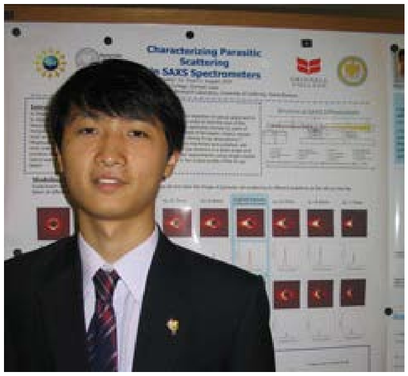
Proteins regulate biochemical pathways in living cells. The over or under expression of these biochemical pathways lead to various diseases. Thus, the development of an analytical bioassay for proteins is of the utmost importance for biomedical research. Nanoparticles have the potential to be luminescent probes for both diagnostic and therapeutic purposes because of size compatibility to many important biomolecules and their novel optical, electronic, and magnetic properties. The controlled synthesis of nanocomposite materials consisting of an inorganic nanoparticle encapsulated within polymer shells is an area of great focus. The polymer shell determines the chemical properties and the interaction with the environment, while the inorganic core and polymer concomitantly control the physical properties (ie. the size and shape) of the composite nanoparticle. In this research, the desire is to synthesize silica-fluorescent dye- polymer- biomarker composites that have the ability to detect bioassays (proteins) more efficiently, with higher sensitivity and lower cost.

Return to the RISE 2007 project list

Education

Undergraduate Opportunities
K-12 Science Activities
For Teachers
Education Contacts
News

Tuo's Project Page - RISE Summer 2007



Intern: Tuo Huang, Physics, Grinnell College
Mentor: Youli Li
Faculty Supervisor: Youli Li
Department: Materials

COMPUTER SIMULATION OF X-RAY PROPAGATION IN SAXS FACILITIES

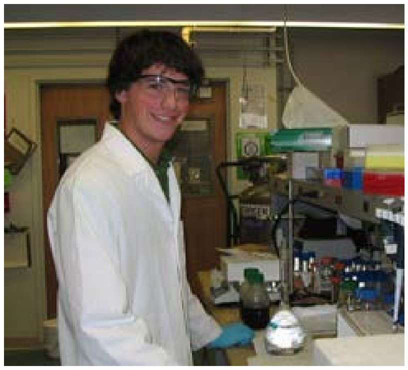
SAXS (Small Angle X-ray Scattering) is a widely used method of microscopic examination in materials research and it provides critical information about the internal structure of the examined biological or chemical macromolecules. In an SAXS facility, the incident X-ray beam must be very well defined by a series of slits to prevent the transmitted beam from overwhelming the signal of the scattered photons. The project focuses on the computer simulation of X-ray propagation to provide reference to the set-up of SAXS facilities in order to optimize the performance of the equipment. At the same time, experimental data with different slit materials can also lead to more efficient designs of SAXS facilities. In the traditional three-slit set-up, parasitic scattering from the slits must be removed to avoid overwhelming the signal of the scattered photon. This is partly what complicates the set-up and makes SAXS facilities much longer in size than their Wide Angle counterparts. The cost of doing so, however, is the attenuated intensity of incident X-ray beam on the samples. It is demonstrated in this research that slits made of single-crystal materials, such as silicon wafer, can greatly improve the profile of the output X-ray beam and potentially bring some changes to the existing set-up. With better slits and optimized arrangement, X-ray beam can be much more efficiently utilized and thus bringing higher quality of results for the user.

Return to the RISE 2007 project list

Education

Undergraduate Opportunities
K-12 Science Activities
For Teachers
Education Contacts
News

Matt's Project Page - RISE Summer 2007



Intern: Matt Lavelle, Chemical Engineering, University of Michigan
Mentor: Guohui Wu
Faculty Supervisor: Joseph Zasadzinski
Department: Chemical Engineering

VESOSOME SIZE REDUCTION FOR USE AS A DRUG DELIVERY VESICLE

In contemporary methods for chemotherapy one of the largest problems is there is no way to effectively target the tumor site with the anti-cancer drugs. As a result these therapeutic drugs destroy both healthy tissue and cancer tissues, resulting in many of the side effects associated with chemotherapy. The traditional liposome carriers are single walled transport vehicles. These vesicles are often not stable during circulation due to associated stresses. One possible way to strengthen these vesicles is to make them multi-chambered, known as vesosomes. However, the traditional preparation results in vesosomes too large to be clinically used. Extrusion is not an option when attempting to control the exterior vesicles diameter due to the high probability that the interior vesicles would be ruptured during the process. Alternatively, by varying the composition of this external wall, it is believed that an arrangement exist in which these vesicles will spontaneously form at a size effective for passive targeting while still maintaining a high encapsulation efficiency of smaller interior vesicles. Experiments have been done with varying compositions of the lipid DPPE, pluronic F68 and F108, and DPPE-PEG, all with DPPC as the primary constituent. It has been observed that DPPE-PEG has the most potential in the formation of the desired size. Research has also shown that incorporating this PEG-lipid is an effective way of preventing an immune response to the vesicles, and therefore increasing the circulation time.

Return to the RISE 2007 project list

MATERIALS RESEARCH LABORATORY at UCSB: an NSF MRSEC
the innovation engine for new materials

Ellis' Project Page - RISE Summer 2007

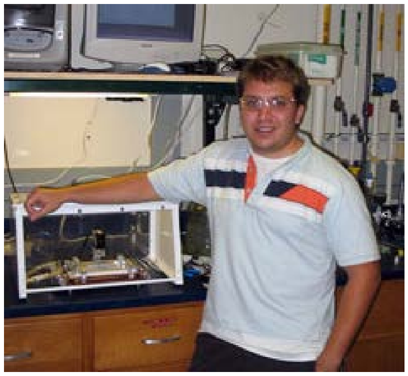
Intern: Ellis Robinson, Chemical Engineering, Ohio State University
Mentor: Ryan Snyder
Faculty Supervisor: Michael Doherty
Department: Chemical Engineering

CRYSTAL SHAPE PREDICTION – A SENSITIVITY ANALYSIS OF THE SPIRAL DISLOCATION MECHANISM MODEL

Abstract pending approval from faculty

Return to the RISE 2007 project list

Jake' Project Page - RISE Summer 2007



Intern: Jake Vestal, Chemical Engineering, North Carolina State University
Mentor: Patrick Stenger
Faculty Supervisor: Joseph Zasadzinski
Department: Chemical Engineering

A SYNTHETIC LUNG SURFACTANT FOR TREATMENT OF RESPIRATORY DISTRESS SYNDROME

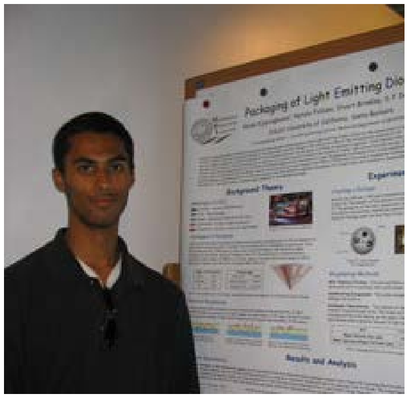
Lung surfactant (LS) is a complex mixture of lipids and proteins (SP-A, B, C and D) that lowers surface tension in the alveoli, thereby insuring a negligible work of breathing and preventing alveolar collapse upon exhalation. LS is functionally inhibited during Acute Respiratory Distress Syndrome (ARDS) which afflicts 150,000 individuals per year with a 40% mortality rate. ARDS is characterized by elevated levels of serum proteins in the alveoli which interfere with the formation of a LS monolayer at the alveolar air-liquid interface. In a related disorder, Neonatal Respiratory Distress Syndrome (NRDS), premature infants which lack functional LS are successfully treated with animal derived replacement LS. Our objective is to develop a synthetic LS that resists inhibition as seen in ARDS and could also be used to treat NRDS at lower cost and avoiding possible contamination issues. A Langmuir trough was used to study the surface properties of different LS mixtures, their response to serum protein inhibition, and subsequent inhibition reversal. Studies on Survanta, an animal derived replacement LS which contains SP-B and SP-C, showed that inhibition could be reversed by treatment with chitosan, CaCl2, and polyethylene glycol. To determine the minimum recipe that would yield a synthetic LS resistant to inhibition, mixtures containing only "Survanta-like" lipids and lipids with SP-B/SP-C peptide analogues were evaluated. Addition of peptide analogs showed improved the surface performance of lipids on a clean subphase. However, results showed that no combination of synthetic lipids and/or peptides resists serum protein as well as Survanta.

Return to the RISE 2007 project list

Education

Undergraduate Opportunities
K-12 Science Activities
For Teachers
Education Contacts
News

Karun's Project Page - RISE Summer 2007



Intern: Karun Vijayraghavan, Electrical Engineering, UC Santa Barbara
Mentor: Natalie Fellows
Faculty Supervisor: Steven Denbaars
Department: Materials

PACKAGING OF BLUE PUMPED-YELLOW PHOSPHOR LIGHT EMITTING DIODES

Surface roughening methods applied to encapsulated blue-pumped yellow phosphor white light emitting diodes (LEDs) for the enhancement in light extraction was studied. Extraction loss due to total internal reflection is present because of the large reduction step change in the refractive index of the encapsulation material (n~1.4 - 1.6) relative to air (n=1). The theory put at test is a higher probability of light transmission if the boundary between the two media is diffuse as opposed to specular. Total internal reflection is less likely to occur for diffuse profiles because of an increase in surface texture and is conducive to a greater amount of phonon flux leading to higher light extraction efficiencies. LED packaging consists of a die encapsulated in a silicone resin having a spatial geometry of cylindrical sidewalls topped with a hemispherical dome. Surface profile analysis via scanning electron microscopy reveals a desirable uniform roughened topography and radiometric measurements of packaged InGaN blue LEDs show a maximum of 7 percent increase in power when compared to unroughened packages.

Return to the RISE 2007 project list

Joshua's Project Page - RISE Summer 2007

Intern: Joshua Walker, Chemistry, Jackson State Univeristy
Mentor: Stephan Kramer
Faculty Supervisor: Carlos Levi
Department: Materials

CMAS- A NEW CHALLENGE FOR THERMAL BARRIER COATINGS IN ADVANCED JET TURBINE ENGINES

The quest for the development of thermal barrier coatings in jet engines, which can withstand extremely high temperatures, is on the rise. Thermal barrier coatings are ceramics that enhance the performance and durability of turbine engines blades. Research in these TBCs is very important for the booming aviation industry. New problems arise once the operating temperatures of these coatings are increased. One of the challenges which this paper focuses on is calcium-magnesium alumino silicate (CMAS). CMAS is a combination of sand, dust, volcanic ash, and runway debris. At lower temperatures contaminants can cause erosive wear to the TBC when impacting as solid debris. At higher temperature CMAS begins to melt when in contact with TBC and infiltrates into the engine blades. The ultimate goal of this research is to shed light on the properties of CMAS and ways to decrease aircraft engine damage. This paper investigates the reaction mechanisms and chemical compositions for rare earth zirconates. The Co-precipitation technique is used to produce the zirconates and to analyze the reaction with CMAS as a function of varying ion size of the rare earth elements. Lanthanum, gadolinium and yttrium zirconates were successfully prepared in the process to find the best solution to this dilemma. The reaction effects and products are discussed further in this paper.

Return to the RISE 2007 project list