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California Alliance for Minority Participation

California Alliance for Minority Participation (CAMP)
Summer 2008 - Student Projects

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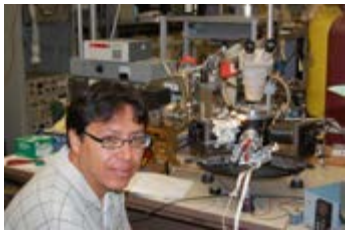
Ernesto's Project Page - CAMP Summer 2007



Intern: Ernesto Carrillo, Electrical Engineering
Mentor: Jeong Min Baik
Faculty Supervisor: Martin Moskovits
Department: Chemistry & Biochemistry Department

VANADIUM-OXIDE VO2 NANOSENSOR BASED ON MOTT TRANSITION

Metal-oxides have been traditionally used as gas sensors. This principle is based on the fact that the surface states which affect the electric properties of material change under different target gases. One-dimensional nanostructures (1-D) of metal oxide semiconductors are currently the subject of intense research both in order to discover fundamental new sciences at the nanoscale as well as for their potential in electronic and optoelectronic device applications. In particular, vanadium dioxide (VO2) is the iconic material which undergoes a Mott metal-insulator transition at a temperature of 68 °C in the bulk. As a result, vanadium oxide has been proposed as a suitable material for constructing thermochromic devices, Mott field-effect transistors, and gas sensors. Here, we report the sensing properties of vanadium oxide based on Mott transition using surface modification method by metal nanoparticles (< 10nm). This principle is based on the formation of a depletion layer and increased reactivity by the nanoparticles. Electrical contacts were deposited onto individual VO2 nanowires residing on the SiO2/Si substrate on which they were grown. The Ti/Au (10/500 nm) electrodes were patterned by a metal mask and deposited using conventional e-beam metal vapor deposition. Pd metal (0.3nm) was then deposited for a surface medication. The sensing properties of a single VO2 nanowire were measured.

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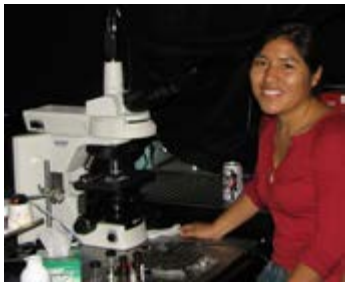
Aurea's Project Page - CAMP Summer 2007



Intern: Aurea Gomez, Chemical Engineering
Mentor: Siyoung Choi
Faculty Supervisor: Todd Squires
Department: Chemical Engineering Department

CHARACTERIZATION OF FERROMAGNETIC DISKS: MAGNETIC MOMENTS AND SURFACE PROPERTIES

To measure the viscosity and elasticity of complex fluid/fluid interfaces, a new technique currently being developed uses ferromagnetic, interfacially-active micro-disks as probes that can be externally torqued. In order to produce quantitative measurements of the dynamic properties at an interface, ferromagnetic disks must be fully characterized. Of great importance are the disks' shape, size, surface properties and magnetic moment. We have designed and synthesized disks with various geometries and deposited ferromagnetic films of varying thicknesses. To determine the disks' magnetic moment, measurements are performed using a novel technique in which the disks are situated in between electromagnets which impose a magnetic field and thus torque. The angular displacement of two holes made on the individual disks is then monitored and recorded over time. Knowing the magnetic field strength and the viscosity of the sub phase upon which the disks lie, the magnetic moment can be calculated using a differential equation derived. One important task of our study is to determine the relationship between different nickel layer thickness on the disks and the magnetic moment of the disk, and thus to optimize our probes. Furthermore, we want to understand how the disks sit at fluid/fluid interfaces, and how this can be controlled. Surface properties are altered by gold thiol chemistry. A monolayer of one of various alkanethiols is formed on the disks' surface and the contact angle of a water droplet with each surface is determined. A gel trapping technique and Scanning Electron microscopy (SEM) are utilized to determine where the disks lie on an air/water interface.

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Diego's Project Page - CAMP Summer 2007

Intern: Diego Herrera, Biology
Mentor: Gabriel Luna
Faculty Supervisor: Steven K. Fisher
Department: Neuroscience Institute

THE ROLE OF PROLIFERATION IN EPIRETINAL MEMBRANES

Following various retinal pathologies such as retinal detachment or diabetic retinopathy, scar tissue known as an “epiretinal membrane” can form on the surface of the retina, often resulting in blindness. Since anti-proliferative drugs have been ineffective in preventing the formation of the membranes, we sought to determine the extent of active cellular proliferation occurring in this tissue and identify the cell types involved with the goal of designing a better treatment strategy. Epiretinal membranes were surgically removed from human eyes and immediately preserved in fixative. Membranes from 4 different conditions were examined: proliferative diabetic retinopathy (PDR), proliferative vitreoretinopathy (PVR), epiretinal membranes post retinal detachment (ERMpRD), and idiopathic epiretinal membranes (iERM). The tissue was then exposed to several different “primary” antibodies to identify dividing cells, glial cells, immune cells, and all nuclei. Following 24 hrs, “secondary” antibodies conjugated to a fluorochrome were then added for an additional 24 hrs. The secondary antibodies bind to the primary antibodies and since they are conjugated to a fluorochrome, fluoresce when illuminated with the proper wavelength of light thus allowing for their visualization. Digital images were collected and the number of dividing cells was counted and correlated with the total number of nuclei present for each condition. The results indicate that cell proliferation is indeed present in the membranes but at relatively l ow levels compared to the total number of cells. Therefore, drugs which only inhibit proliferation may not be adequate to stop the formation of epiretinal membranes.

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Daniel's Project Page - CAMP Summer 2007

Intern: Daniel Orosco, Cell and Developmental Biology
Mentor: Nathan Bouxsein
Faculty Supervisor: Cyrus Safinya
Department: Materials Department

THE ROLE OF PROLIFERATION IN EPIRETINAL MEMBRANES

There is growing interest in small interfering RNA (siRNA) due to its promise as a method to combat diseases such as cancer. With its unique ability to silence genes post transcriptionally the main focus of this area of research has been to develop an efficient method of delivery. Cationic lipoplexes (CL) have been studied as a means to encapsulate siRNA and protect it from degradation inside the body. Stability of these CL-siRNA lipoplexes is crucial for efficient gene silencing inside the cell. The formation of these complexes was studied to optimize the lipoplex vector because of CLs toxic effects in the body. New strategies have been employed to solve the toxicity issue by using multivalent lipids, such as MVL5, which can carry more charges on a single lipid head group. These multivalent lipids, which can range from +3 to +16, create stable complexes as seen from ethidium bromide exclusion assays. Poly Acrylamide Gel Electrophoresis will be conducted to ensure the results seen through the ethidium bromide exclusion assays are comparable. Transfection assays will be conducted to measure the ability of the siRNA-lipoplexes to deliver their siRNA cargo and silence reporter genes in the cells. The ultimate goal is to optimize this delivery system so that the least amount of lipid can be used while still ensuring a high transfection efficiency. The success of these experiments will help to further the study of siRNA-lipoplexes as a gene therapy tool.

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Gilberto's Project Page - CAMP Summer 2007

Intern: Gilberto Salvador Ponce, Physics Department
Mentor: Connor Randall
Faculty Supervisor: Paul Hansma
Department: Physics Department

BONE DIAGNOSTICS INSTRUMENT

Due to the rise in population affected with osteoporosis, there is an increasing need for early detection of the disease to prevent fractures and possible health risks. There currently exist methods of testing for osteoporosis. A cheaper and more convenient alternative is the use of the Bone Diagnostics Instrument (BDI) to test for the material properties of bone. The BDI uses a test probe to make indentations into the surface of the bone. Mapping forces and distance curves, the data can be analyzed to give a measurement of initial hardness, elastic modulus, and Indentation Distance Increase (IDI). These results can aid in determining a person's bone density to determine how susceptible they are to osteoporosis. Repeated experiments using the BDI on a variety of bones is necessary for the development and perfection of the apparatus. We tested different rat bones, with a known diet, and compared the IDI unit results to determine a sample's material properties. The development of this instrument is crucial to the rising demand of inexpensive osteoporosis testing.

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Maria's Project Page - CAMP Summer 2007

Intern: Maria Esther Salado, Biopsychology
Mentor: Mickey Rowe
Faculty Supervisor: PMickey Rowe
Department: Neuroscience Research Institute

THE EFFECT OF DISTRACTOR COLOR HETEROGENEITY ON VISUAL SEARCH PERFORMANCE

A lot of time and effort is spent looking for things. Often it is critically important that we quickly and effectively find that which we seek. Here we studied how effectiveness is affected by color and location. Specifically, we examined the role that color heterogeneity plays when doing a visual search task. We presented subjects with displays that contained at most one target, defined by a diamond shape, on a display that contained 288 distractors. Each display contained no more than two different colors (including the target) out of a choice of five. Accuracy of how many times the diamond was found and correctly located was then measured through the subject's keypad responses. The data was analyzed according to three parameters: the number of distractors that matched the target color, the distance of the target from the cross, and the color of the target. We found that the likelihood of subjects finding the target is greatly reduced when more than one distractor color shares the target color. This effect is generally stronger when the target is farther away from the subjects' initial fixation point. However, at some distances, subjects are more likely to find the target when all shapes are the same color than if only some of them is different. Target color also impacts the effect of heterogeneity as yellow and green targets (which had low brightness contrasts against the background) are generally harder to find than (high contrast) red and blue targets particularly at the highest heterogeneity levels. With our results and further research, we hope to better understand ways to color code displays of critical visual information.

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Ruben's Project Page - CAMP Summer 2007

Intern: Ruben Salazar, Mechanical Engineering
Mentor: Jonathan Adams
Faculty Supervisor: Hyongsok (Tom) Soh
Department: Mechanical Engineering Department

MAGNETIC ACTIVATED PEPTIDE SELECTION

Molecular affinity reagents have become the cornerstone of modern biotechnology, with a range of applications from medical treatments to studies of cell molecular recognition processes. One important method of creating high-affinity reagents is through in vitro evolution methods – a systematic approach of screening and amplifying molecules displaying affinity to a target molecule. Species bound to the targets are chemically amplified, and the process is repeated. However, with current technologies, this process is inefficient, highly expensive, and requires a lengthy development time. Consequently, there remains an urgent need for technologies to identify and produce ligands. Towards this end, we are developing extremely rapid screening technologies to select and evolve affinity reagents using magnetic selection technology. By labeling target species with superparamagnetic microspheres, we can efficiently separate the targets and bound species from the unbound species using magnetic forces. Additionally, because of the strong magnetic forces present, we can achieve extremely effective washing away of unbound objects. Preliminary results indicate that our strategy may achieve exceptionally high (~106) ratio of desired-to-undesired object separation. Further research will focus on optimization of the experimental conditions toward the demonstration of the technology through the selection of a peptide affinity reagent.

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Shasta's Project Page - CAMP Summer 2007

Intern: Sasha Shekhar, Molecular, Cellular and Developmental Biology
Mentor: Herbert Waite
Faculty Supervisor: Herbert Waite
Department: Biomolecular Science and Engineering

THE CHEMICAL AND MECHANICAL CHARACTERIZATION OF SILICIFIED AND IODINATED PROTEINS IN THE CALIFORNIA SANDCASTLE WORM, PHRAGMATOPOMA CALIFORNICA

Characterizing and identifying the biochemical and mechanical properties of hard materials can provide valuable insight into the means by which biological materials function while promoting the advancement of engineering and materials science. Iodinated and silicified proteins are examples of materials that have tremendous medical and biological significance as well potential uses in materials science. While the operculum of Phragmatopoma californica is an amalgam of these two materials little is known about this structure. To determine the composition of this structure, energy dispersive spectrometry (EDS) was conducted in tandem with scanning electron microscopy (SEM). This preliminary study provided insight into the elemental composition and distribution of Iodine, Silica, Oxygen and Nitrogen. While observations made from SEM and EDS analysis are fairly substantive, further data will provide insight into the exact arrangement of these variable components and the mechanical properties they provide. To further test these data and determine what relationship exists between the mechanical properties of the material and its variable composition, nanoindentation will be conducted as means of determining hardness. These calculations and analyses followed by rigorous protein composition and sequencing data of this material will provide valuable information that can further the fields of biology, biochemistry and material science.

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Octavio's Project Page - CAMP Summer 2007

Intern: Octavio Sifuentes, Department of Physics
Mentor: Mickey Rowe
Faculty Supervisor: Mickey Rowe
Department: Neuroscience Research Institute

COLOR VISION MECHANISMS FOR UNIQUE HUES

It is well established that different physical stimuli can produce the same color perception, but presumably similar color perceptions result from similar nervous system activity. Four hues, unique red, green, blue and yellow have been identified as special and it is generally believed that what makes them special is that people have perceptions of these when there is balance between opposing physiological mechanisms. This suggests that the analysis of stimuli that produce unique hue experiences can improve our understanding of the neural processes that create color perception. We produced unique hue sensations with two experiments utilizing very different wavelength distributions. In one experiment we determined the peak wavelengths of narrow band lights producing three of the four unique hues. In the other we ran a replica of an experiment described in Wuerger et al. (2005), which produces unique hue sensations using a computer monitor and hence broadband stimuli. We extended this experiment by adding higher background luminance and testing color vision deficient subjects. We will directly compare the data from these experiments to assess the extent to which all results can be explained assuming balance of the same mechanisms. Color deficient subjects presumably utilize similar opponent processes differing from normals primarily via differences in receptor spectral sensitivities. If unique hues are perceived when opposing physiological processes are balanced, then models of this balance produced by one type of stimulus should predict the stimuli that would produce unique hue sensations by other types of stimuli within each individual.

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Tanya's Project Page - CAMP Summer 2007

Intern: Tanya Rose Taylor, Earth System Science
Mentor: Dorothy Pak
Faculty Supervisor: Dorothy Pak
Department: Earth Sciences, Marine Science Institute and Materials Research Laboratory

LATEST HOLOCENE CLIMATE RECORD INFERRED FROM PLANKTONIC FORAMINIFERA IN SANTA BARBARA BASIN

High-resolution, multi-proxy paleoclimate records provide insight into decadal climate cycles, as exhibited during the Medieval Climate Anomaly (MCA) and the Little Ice Age (LIA). Sediment cores collected from Santa Barbara Basin (SBB) on a 2005 R/V Melville expedition are employed in the investigation of sea-surface temperature (SST) fluctuations during the MCA (1400-800 years BP) and the LIA (800-330 years BP). From the cores recovered (MV0508-32), morphological analysis of dextrally and sinstrally coiled species of Neogloboquadrina pachyderma yields a qualitative record of changes in SST's. The N.pachyderma coiling record indicates warming SST's during the MCA and cooling SST's during the LIA. Earlier MV0508-32 Mg/Ca data of N.pachyderma (d.), Globigerina bulloides and Globigerinoides ruber corroborates the coiling record trends. Additionally, prior analysis of N.pachyderma (d.) ?18O from MV0508-32 correlates with another core from SBB, Ocean Drilling Program Hole 893A. Published ?18O-based SST reconstructions from Hole 893A show a converse progression during the MCA and LIA, implying a different expression of these events in SBB than in the North Atlantic. However, assessment of MV0508-32 data suggests that the MCA and LIA were of global magnitude, calling to question the use of ?18O as a proxy for SST's in SBB. Pending trace metal, ?14C, and ?18O analyses will aid in the continued exploration of late Holocene changes in SBB surface waters and the origins of the driving mechanism for MCA and LIA climate forcing.

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Lourdes' Project Page - CAMP Summer 2007

Intern: Lourdes Velazquez, Biology
Mentor: Patrick O'Neill
Faculty Supervisor: Deborah Fygenson
Department: Physics Department

FLUORESCING SILVER NANOCLUSTERS ON DNA

Combining DNA and silver ions and then reducing the solution with NaBH4 causes silver clusters to attach themselves to DNA and emit fluorescence depending on the sequence and structure of the DNA they are interacting with. Little is known about these fluorophores but the use of fluorimetry, mass spectroscopy and absorbance measurements is enabling us to reveal more information on the stability, components and quantum yield of these structures. We have been working most extensively with a DNA hairpin that has a 7 base-pair stem and closes in a single stranded loop of 9 cytosines. Different concentrations of silver yield different peaks in fluorescence causing us to believe that different number of silver atoms attached to the DNA structure account for this difference. Doing mass spectroscopy of our 9C green-fluorescing clusters yielded a high peak in the 11 atom cluster but also smaller peaks in other cluster sizes. Using gel electrophoresis we were able to purify our clusters to get the same fluorescing green peak and only one peak, the eleven atom peak, in the mass spectra. This proves that it is the eleven silver atom cluster that causes the green peak fluorescence given off by our 9C hairpins. The study of these DNA and silver nanoclusters may enable us to study light-matter interactions on very small distance scales in a controllable manner. They could also potentially serve as fluorophores for bio labeling that could be more photostable than organic dyes and smaller in size than semiconductor nanocrystals.

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