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Specificity of Cyclic RGD Peptides for the $\alpha_v\beta_3$ Integrin

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Integrins are cell surface receptors responsible for cell-matrix adhesion and play a vital role in angiogenesis. The $\alpha_v\beta_3$ integrin is overexpressed on activated endothelial cells and some tumor cells. Activated integrin $\alpha_v\beta_3$ binds to the arginine, glycine, aspartate (RGD) sequence of matrix proteins including fibronectin and vitronectin. This study was done to determine the specificity of cyclic RGD peptides for the $\alpha_v\beta_3$ integrin in the glioblastoma cell line U87. U87 cells were transfected with siRNAs that targeted either α_v or β_3 for knockdown of the respective subunits. Flow cytometry (FACS) was performed to measure the cell-surface protein levels of the targeted subunits at day 3 post-transfection. Cellular uptake of ^{64}[Cu]DOTA–c(RGDfk) was measured in transfected cells, and compared to control cells. A correlation between decreased protein levels and decreased uptake indicates specificity of the peptides for the $\alpha_v\beta_3$ integrin. RDG peptides may provide a method of drug delivery specific for $\alpha_v\beta_3$-expressing cancers.

Wildland Fires: Spotting Ignition by Embers

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Firebrand spotting is a primary mechanism causing flame propagation in wildland and wildland-urban-interface fires. Firebrand spotting occurs under dry, hot, and windy conditions. Spotting occurs when a fire produces flaming or glowing embers that are transported by the wind downstream of the primary flame front which then starts secondary fires. The aspect of spot fire formation that is least understood is what happens after a firebrand lands on a target fuel bed. A Spotting Ignition Test apparatus consisting of a small scale wind-tunnel 38cm long with a cross –section of 13.5cm by 8cm has been built to investigate the ignition of fuel beds. Birch firebrands of uniform cylindrical geometry are ignited and dropped onto a powdered cellulose fuel bed. Both smoldering and flaming embers and a range of air flow velocities are examined. Flaming brands ignite the surface of the cellulose consistently for all conditions. Smoldering brands do not cause transition to flaming for any conditions tested.

Optical Constants of Thin-Film Tantalum

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Extreme Ultra-Violet (EUV) photolithography has several applications, including printing computer chips. In most of these applications, a higher resolution brings several advantages, including greater speed and less heat generated. One path to higher resolution involves using the shorter wavelengths present in EUV. However, EUV interaction with films intended to block the light is unknown. Absorption and transmission must be measured precisely so that films can be engineered. Tantalum is typically used as a filter in EUV lithography. In order to measure its optical constants – absorption and transmission – a thin, free-standing film was developed. It was measured by passing varying monochromatic light through the film of known thickness and determining transmission. This gave a correction to the previously-accepted values for tantalum, and is a step toward successful EUV lithography, as well as having applications in other areas.

Improving the Whole Cell Biocatalytic Properties through Protein Engineering of LovD

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Simvastatin, a cholesterol-lowering compound, is the main component of the top selling drug Zocor. Simvastatin has traditionally been produced through a tedious, complex chemical synthesis from the natural product lovastatin. Our lab has characterized an acyltransferase, LovD, that allows simvastatin to be synthesized in one step. Through fermentation, an *Escherichia coli* strain overexpressing LovD acts as a whole cell biocatalyst to convert the precursor monacolin J and the substrate DMB-SMMP to simvastatin. In this study we performed site-directed mutation of cysteine to alanine to observe if LovD would increase in solubility and activity without cysteine residues. Here we report the characterization of nine LovD mutants, each with one cysteine converted to alanine. Mutations in LovD of the cysteine at position 40 and the cysteine at position 60 to alanine gave mutants with higher solubility than wild-type LovD and increased whole cell biocatalytic conversion by ~1.4 fold.

The Impact of Macroalgal Mats on the Trophic Support of Migratory Shorebirds in Southern California Estuaries

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Infauna are the main food source for migratory shorebirds therefore, it is crucial to understand how macroalgal mats affects the infaunal abundance. This study investigated whether infaunal abundance was negatively impacted by macroalgal mats in Mugu Lagoon, in Southern California. A field experiment was conducted with 21 cages divided into zero, low and high macroalgal treatments. Infauna and sediment cores were taken every 2 week for 8 weeks. Analysis of infaunal cores showed an increase in infaunal

abundance regardless of treatment. Sediment cores were used to investigate if a relationship existed between sediment chlorophyll-a and infaunal abundance. Chlorophyll analysis showed that as macroalgal densities increased, chlorophyll-a also increased. The high macroalgal treatment had the highest amount of chlorophyll-a throughout the 8 weeks. This study will provide insight on how macroalgal mats impact infaunal abundance and shorebird foraging in Southern California estuaries.

Mercury Partitioning in Post-fire Soils in Piru Creek

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Fires may cause an increase in Mercury (Hg) methylation, so determining the extent of Hg mobilization to downstream systems is critical because methyl Hg is a neurotoxin that biomagnifies in foodwebs. We hypothesize that vegetation loss and an increase in soil hydrophobicity cause Hg to be transported into stream channels following a fire. We also hypothesize that soil particle size directly influences the transport of Hg since binding is stronger in finer soils. Vertical profiles of unburned and post-fire soil samples within Piru Creek Watershed were collected, partitioned using soil sieving analysis, and analyzed using the Milestone Direct Mercury Analyzer to quantify Hg concentrations. Preliminary results support our hypothesis that Hg binds predominantly to finer soils and that a total loss of Hg occurs at the soil surface following post-fire rain events. Recovery is also evidenced by atmospheric deposition of Hg at the soil surface.

Experimental Measurements of the Effective Thermal Conductivity and Interface Conductance of a Lithium Metatitanate Pebble Bed

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To sustain fusion reactions, tritium self-sufficiency is required. Tritium can be produced by neutron irradiation of lithium ceramic fusion blankets. The thermal performance of a fusion blanket is dependent on the properties of the lithium ceramic. This project aimed to quantify the effective thermal conductivity and interface conductance of a Lithium Metatitanate/Helium pebble bed. The experiment employed the steady-state axial heat flow method. Although data agreed with previous experiments using the same apparatus, effective thermal conductivity (**k_{eff}**) values were lower than previously reported and decreased with temperature. Previous research has shown that **k_{eff}** rises with temperature. Additionally, negative interface conductance (**h**) values were recorded, which indicates that heat flowed through the walls instead of the bed. However, the data collected are still valuable for heat transfer analysis. The knowledge gained will go toward blanket designs to be tested in ITER (International Thermonuclear Experimental Reactor).

Understanding the Role of BLIMP1 in Human Germ Cell Differentiation Using HESC Model

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Blimp1 plays a critical role in the specification of primordial germ cells (PGCs) in mice. Blimp1 interacts with Prmt5 to direct H4R3 histone methylation in mouse germ cells, providing transcriptional regulatory control. PGCs are the first embryonic cells to develop during germ line formation. In humans, malformation of PGCs leads to non-functional sperm and eggs, germ cell tumors or congenital birth defects. The hypothesis is that BLIMP1 and PRMT5 have similar function in the human germ cell lineage. To examine human PGC formation, human germ cell lineage is differentiated from embryonic stem cells (hESCs) and the expression pattern BLIMP1, PRMT5, and H4R3 is examined. Preliminary results indicated that BLIMP1, PRMT 5 are expressed in the cytoplasm of undifferentiated hESCs and H4R3 is specifically expressed in the nuclei. Undifferentiated hESCs share transcriptional similarities with PGCs, and therefore molecular programs essential for PGC development could be learned from hESC study.