

**Second Annual**  
**Columbia-Willamette Sigma Xi**  
**Student Research Symposium**

**Friday, April 21, 2006**  
**1:00 - 5:00 pm**

**Smith Memorial Student Union Ballroom**  
**Portland State University**

*Abstracts of Posters*



# BEHAVIORAL SCIENCE

## Graduate Student Posters

RESEARCH DESIGN IN ARCHAEOLOGICAL INVESTIGATION NUTRITION, HEALTH AND SOCIAL PRACTICE AT FORT VANCOUVER: THE DIVERSE ROLES OF DR. MCLOUGHLIN'S GARDEN, Elaine Dorset, [edorset@qwest.net](mailto:edorset@qwest.net), Dr. Doug Wilson [Doug.Wilson@nps.gov](mailto:Doug.Wilson@nps.gov), Dept. of Anthropology, Portland State University

In the 19th century, John McLoughlin, Chief Factor of Fort Vancouver and the Hudson's Bay Company's Columbia District (1828-1845), was one of the most powerful leaders on the west coast of North America. McLoughlin's formal garden at Fort Vancouver was a symbol of the power of the Hudson's Bay Company and had an important ideological and material influence on the economic and social development of the Pacific Northwest before and during the time of American settlement. It also significantly influenced changes in subsistence behavior by American Indians in the Pacific Northwest in the 19th century.

An archaeological project by a joint Portland State University, Washington State University and National Park Service team assists in the investigation of McLoughlin's Garden by a joint Portland State University and National Park Service team and will assist in the completion of a Master's Thesis that will expand landscape approaches to archaeology in the Pacific Northwest and provide resources for the management and interpretation of the garden site by the National Park Service at Fort Vancouver National Historic Site.

Test excavations were conducted at the site during the 2005 field season. Preliminary results from these excavations will direct the research design for 2006. This poster illustrates how the 2005 preliminary data will be utilized to formulate research questions and excavation strategies to obtain information which will enhance our understanding of the diverse roles of McLoughlin's Garden in health, nutrition and social practice at Fort Vancouver.

ZOOARCHAEOLOGY AND THE URBANIZATION OF VANCOUVER, WA, 1876-1918, Krey Easton [krey@pdx.edu](mailto:krey@pdx.edu) and Virginia Butler, Anthropology Department, Portland State University

With increased industrialization during the 19th century, America made a monumental shift from an economy based on rural subsistence to one dominated by urban wage labor and large-scale manufacturing. With this shift, increasing numbers of people moved from rural areas to growing urban centers where they became reliant on a rapidly expanding capitalist market system ultimately controlling access to goods, including the availability of food. This change from rural to urban foodways happened rapidly in places such as the East Coast with advances in the transportation infrastructure, but in the more remote areas such as the Pacific Northwest, the

timing of this transition is less well understood. The late 1800s is a critical time in the development of places such as Vancouver, WA. The infrastructure and social atmosphere was dramatically changing the way people consumed and disposed of goods, and the lack of sanitation laws meant refuse was still deposited informally in backyards. This accumulation of household waste provides zooarchaeologists a unique opportunity to explore how household diets reflect the social changes associated with increased urbanization. This poster presents the preliminary results of an archaeological study of the faunal material recovered during excavations of over 30 refuse features dating between ca. 1876 to 1918 within six city blocks located in Vancouver, WA. The goal of this study is to better understand local consumption of animals, and to determine how faunal remains can be indicators of socioeconomics, consumer choice, and how they can provide clues of increasing urbanization and formalization of the market system.

ARTIFACT ASSEMBLAGES AND LANDUSE: PREHISTORIC SETTLEMENT PATTERNS IN THE PORTLAND BASIN, William C. Gardner-O'Kearny [w.gardner-okearny@comcast.net](mailto:w.gardner-okearny@comcast.net), Paul S. Solimano [paul@aar-crm.com](mailto:paul@aar-crm.com), and Ken Ames [amesk@pdx.edu](mailto:amesk@pdx.edu), Department of Anthropology, Portland State University

Passage of archaeological site protection ordinances in the early 1990s dramatically increased the number of sites identified, tested, and excavated in the Portland Basin. This data, however, has not been synthesized and discussions of basin archaeology remain particularistic and synchronic. This study is a preliminary synthesis of regional archaeological data. It uses excavated assemblages from 44 riverine and interior sites spanning the last 8,000 years and employs common models of hunter-gatherer landuse. Under these models, prehistoric landuse is largely determined by subsistence strategies aligned on a scale from foragers to collectors. Foragers are highly mobile, moving residential camps to follow resources, while collectors are relatively sedentary, employing logistical task groups to acquire resources. Differing strategies should be discernable using assemblage taxonomic richness and evenness values at different points on the landscape. For instance, logistical task sites should be consistently taxonomically poor and uneven. In the Pacific Northwest, the shift to a logistically oriented system is thought to have occurred between 2000 and 4000 bp, although the timing and causes are debated. This poster examines this shift in the Portland Basin. Early sites conform to expectations for highly mobile foragers, while later prehistoric sites suggest low residential mobility with increased logistical movement. However, the pattern is not perfect. Data gaps are identified, methodological issues discussed, and future research suggested.

CONCEPTUALIZING AND MEASURING THE SELF IN CHRONIC ILLNESS, Jessica Morea B.A. [jmorea@pdx.edu](mailto:jmorea@pdx.edu), Ronald Friend, Ph.D. [rfriend@notes.cc.sunysb.edu](mailto:rfriend@notes.cc.sunysb.edu), Department of Psychology, Portland State University, and Robert Bennett, M.D. Department of Medicine, Oregon Health & Science University

It is well recognized that individuals with the same disease severity adjust differently, sometimes widely, to chronic illness. One factor that may determine reactions to illness is the extent to which illness comes to permeate the self. Illness self-concept, derived from the theories of Kurt Lewin and Solomon Asch, describes the state of illness within the self. Illness central to self refers to the situation where illness lies close to the core self, affecting all regions of the self. Illness peripheral to self refers to the situation where illness is a peripheral component of the self and where the pre-existing self remains a central core, directing how illness is experienced. The purpose of this study was to conceptualize and develop a new "illness self-concept" scale and examine its relationship to adjustment in fibromyalgia patients. Fibromyalgia is a complex chronic pain disorder, associated with changes in central pain processing, afflicting about 5% of all women. An increased understanding of its biopsychosocial underpinnings is essential in formulating appropriate management strategies. One hundred and nine fibromyalgia patients were assessed for illness self-concept (Cronbach's Alpha .94), disease status (FIQ), depression (BDI), and quality of life. After controlling for disease status, illness self-concept predicted greater depression ( $R^2\Delta = 26\%$ ,  $p < .001$ ) and poorer quality of life ( $R^2\Delta = 32\%$ ,  $p < .001$ ). Illness self-concept also predicted over and above other indicators of adjustment in chronic illness, including optimism, self-esteem, and illness intrusiveness.

## Undergraduate Student Posters

DEAR DAD OR "DADDY DEAREST" AND CHILDREN OF DIVORCE, Tiffany A. Graves, [tigraves@wou.edu](mailto:tigraves@wou.edu), Nicolle M. Clemmer, Erin E. Machan, and Kathryn L. Thompson, [thompsk@wou.edu](mailto:thompsk@wou.edu), Psychology Department, Western Oregon University

There are an increasing number of stepfamilies in the United States (Love & Murdock, 2004). Stepfamilies are associated with difficulties and challenges. Family transitions can affect children's functioning (Ruschena, Prior, Sanson, & Smart, 2005) and increase parental stress (Nielsen, 1999). Research suggests that children have increased likelihood of negative outcomes (Love & Murdock, 2004). Students' relationships with parents, students' memories, and perceptions of parents and stepparents were measured and compared. Memories of parents were measured by four different forms of the Parental Caregiving Style Scale, including caregiver warmth, responsiveness, and consistency (one form for each of four types of parents: both step and biological parents). Students' perceptions of

current relationships with four different types of parents were measured on four different forms of the Inventory of Parent Attachment Scale, which measured perceptions of trust, communication, and closeness with a particular parent. A one-way repeated-measures ANOVA indicated a significant difference between participants' responses to the Caregiving Style Scale for all parents (Wilks multivariate criterion, = .71,  $F(3, 34) = 4.59$ ,  $p = .008$ ). Post hoc comparisons indicated that students remembered mothers more positively than other parents. A one-way repeated-measures ANOVA indicated a significant difference between participants' responses to the Inventory of Parent Attachment Scale for all parents (Wilks multivariate criterion, = .61,  $F(3, 23) = 4.83$ ,  $p = .009$ ). Post hoc comparisons indicated that students perceived current relationships with mothers more positively than other parents, except stepfathers. These results are discussed in relation to literature on roles, stressors, and satisfaction in parent-child relationships.

MENSTRUATION TABOOS, A SURVEY, Britt Howard, [bgh@pdx.edu](mailto:bgh@pdx.edu), Dr. Cameron Smith, [smithcm@pdx.edu](mailto:smithcm@pdx.edu), Anthropology Dept., Portland State University.

The practices and taboos surrounding menstruation are extensive and vary from culture to culture. For instance, menstruation taboos in hunter-gatherer societies differ from those of urban societies, perhaps due to religious or social differences. Historically it had been noted that taboos and related female pollution beliefs were in place to oppress women, leaving them subordinate. More recent investigation, however, has indicated that menstrual taboos can enhance the power of women and can offer gender-exclusive ritual powers. The poster serves as an introduction and partial survey (using ethnographies and HRAF data) of menstrual taboos, focusing first on the differences between hunter-gatherers and urban societies and second, classifying the noted taboos, related violations and penalties for breaking taboos.

FRAMING WAR: AN IN-DEPTH LOOK AT THE OREGONIAN'S COVERAGE OF THE WAR IN IRAQ, Erin Snider\* ([snidere@pdx.edu](mailto:snidere@pdx.edu)), Aaleeya Spence, and Dani Stonehocker; Cynthia Lou Coleman ([ccoleman@pdx.edu](mailto:ccoleman@pdx.edu)), Dept. of Communication, Portland State University

The researchers used framing theory (Iyengar, 1991) to examine episodic and thematic newspaper coverage of the Iraq war in Oregon's premier newspaper, *The Oregonian*. The authors hypothesized that, in line with prevailing theory, news stories would be framed along episodic lines. After conducting a content analysis of 192 randomly selected articles, the authors found that, contrary to expectations, *The Oregonian's* coverage included nearly equal number of episodic and thematic news articles. The authors discuss the implications of their findings, including the view that the state's landmark newspaper may provide readers with a broader spectrum of views.

# BIOLOGY

## Graduate Student Posters

OPENING MITOCHONDRIAL ATP-DEPENDENT K<sup>+</sup> CHANNEL INCREASES SUPEROXIDE GENERATION FROM COMPLEX I OF THE ELECTRON TRANSPORT CHAIN, Anastasia Andrukhiy\*, [nastia@pdx.edu](mailto:nastia@pdx.edu), Alexandre D. Costa, Ian C. West, and Keith D. Garlid, [garlid@pdx.edu](mailto:garlid@pdx.edu), Department of Biology, Portland State University

Opening the mitochondrial ATP-sensitive K<sup>+</sup> channel (mitoK<sub>ATP</sub>) increases reactive oxygen species (ROS) levels in cardiomyocytes; however the mechanism by which mitoK<sub>ATP</sub> opening leads to increased ROS levels has not been established. We examined ROS production in suspensions of isolated rat heart and liver mitochondria, using fluorescent probes that are sensitive to hydrogen peroxide. When mitochondria were treated with agents that cause opening of mitoK<sub>ATP</sub>, including diazoxide and cromakalim, protein kinase G plus cyclic GMP, or 4-phorbol-12- $\beta$ -myristate 13-acetate (PMA) we observed increase production of H<sub>2</sub>O<sub>2</sub>. This increase in ROS was inhibited by the mitoK<sub>ATP</sub> blocker 5-hydroxydecanoate. Valinomycin (1 pmol/mg mitochondrial protein), a K<sup>+</sup> ionophore, caused an equivalent increase in K<sup>+</sup> inflow and an equivalent increase in ROS production, thus mimicking the effect of mitoK<sub>ATP</sub> opening. Using a matrix-loaded fluorescent pH indicator we confirmed the predicted increase in matrix pH upon addition of cromakalim, PMA, or valinomycin. Equivalent matrix swelling (by suspending mitochondria in hypo-osmotic media) did not affect ROS production, whereas alkalization of the medium increased ROS production. We therefore conclude that mitoK<sub>ATP</sub>-mediated signaling in respiring mitochondria is due to an increase in ROS production, caused by raised matrix pH as K<sup>+</sup> ions replace expelled protons.

WATER RELATIONS IN THE INVASION OF *RUBUS ARMENIACUS* (HIMALAYAN BLACKBERRY) IN THE PACIFIC NORTHWEST, Joshua S. Caplan\*, ([jcaplan@pdx.edu](mailto:jcaplan@pdx.edu)), J. Alan Yeakley ([bwjy@pdx.edu](mailto:bwjy@pdx.edu)), Environmental Sciences & Resources Program, Portland State University

*Rubus armeniacus* (Himalayan blackberry) is among the most prolific invasive plants in the Pacific Northwest. This research will determine if *R. armeniacus*' invasiveness comes, at least in part, from a superior ability to cope with this region's highly variable water availability.

In a field study we are investigating how *R. armeniacus* and three of its native shrub competitors compare in their abilities to maintain water potentials and transpiration rates as soils change from moist to dry. The three native competitors include *Rubus spectabilis* (salmonberry), *Sambucus racemosa* (red elderberry), and *Symphoricarpos albus* (snowberry). In a greenhouse study we are evaluating how *R. armeniacus* and the same three native species

compare in terms of growth rate, stomatal conductance, and water-use efficiency under differing soil moisture and light regimes.

We expect to show that *R. armeniacus* does not become as water-stressed as the native species in drier soils and that its diminished water stress is associated with a higher water-use efficiency. Further, we expect to show that superior water relations in *R. armeniacus* are associated with rapid growth rates compared to the native shrub competitors.

HEALTHY ECOSYSTEMS ARE GOOD FOR YOUR HEALTH, Laurie J. Dizney, [dizneyl@pdx.edu](mailto:dizneyl@pdx.edu), Philip D. Jones, Luis A. Ruedas, [ruedas@pdx.edu](mailto:ruedas@pdx.edu), Department of Biology and Museum of Vertebrate Biology, Portland State University

In recent years, there has been a surge of newly emerging infectious diseases affecting humans, such as Ebola, West Nile Virus, SARS, Avian Influenza, and Hantavirus. These are all zoonotic diseases—diseases carried by wildlife—that periodically spill over and spread in human populations. As human populations expand and come into more frequent contact with wildlife, these spillovers will inevitably increase in number. Can such events be predicted or prevented? This research investigates the inverse relationship between natural biodiversity and the incidence of zoonotic disease, specifically Hantavirus. The three-year study is being conducted in five natural areas around Portland, OR that vary in size and vegetation. Small mammals are trapped using a web sampling grid, in order to achieve accurate density measurements, as well as consistency with other studies. Blood samples are tested for hantaviral antibodies using ELISA. Population density is calculated using the program DISTANCE. Statistical analyses are undertaken using SAS and SPSS. We have sampled 5000 specimens and found Hantavirus-positive deer mice (*Peromyscus maniculatus*), the natural host, in all parks. Using non-linear regression, we have found a strong significant negative relationship between site biodiversity and percent infection rate: that is to say, as biodiversity decreases, the prevalence of Hantavirus in the ecosystem increases, and exponentially so when diversity becomes very low. This result has clear implications for both human health and conservation efforts: by managing natural areas to maximize biodiversity, zoonotic diseases and their associated risks to humans can be minimized.

THE MOLECULAR CHARACTERIZATION AND CO-EVOLUTION OF PACIFIC NORTHWEST HANTAVIRUS AND DEER MOUSE (PEROMYSCUS), Philip D. Jones ([pdjones@pdx.edu](mailto:pdjones@pdx.edu)), Laurie J. Dizney, Luis A. Ruedas, Ph.D. ([ruedas@pdx.edu](mailto:ruedas@pdx.edu)), Department of Biology and Museum of Vertebrate Biology, Portland State University and Oregon Public Health Lab

Sin Nombre virus (SNV), hosted by the deer mouse, *Peromyscus maniculatus*, is the primary etiological agent of Hantavirus pulmonary syndrome (HPS) in the western United States. HPS, pathogenic only to humans and to which there is no cure, exhibits a

40% mortality rate, down from 70% through earlier diagnosis and fluid management.

The deer mouse has been co-evolving with *Hantaviruses* in isolation from Murines and Arvicolines for approximately 20-30 million years, since the first murids crossed the Bering land bridge and evolved into the Sigmodontines found in the new world today. Currently, deer mouse phylogeny is unclear, and as a result so too is the associated viral phylogeny with twelve *Hantavirus* species presently characterized on the continent. New species are regularly being elucidated from among these former host conspecifics revealing the likelihood of many uncharacterized *Hantaviruses* as well.

To improve our understanding of these phylogenetic and co-evolutionary relationships, as well as the epidemiology of HPS, specimens of both have been collected from throughout the Portland, OR region. Analyses of the ND3, ND4, and ND4L mouse mitochondrial genes have rendered 4% genetic divergence among regional deer mice from the Newfoundland type locality specimens. Sequencing and phylogenetic comparison of the regional viral G2 glycoprotein coding gene have also shown 4% genetic distance from Sin Nombre type specimens to reveal the possibility of new species status for both the local deer mouse and its *Hantavirus*.

**THE BIOGEOGRAPHY OF NORTHWESTERN MONTANE MAMMALS: ECOLOGICAL AND GENETIC COMPARISONS OF MOUNTAINTOP COMMUNITIES**, Zachary T. Harlow\*, [zharlow@pdx.edu](mailto:zharlow@pdx.edu), Debbie A. Duffield, Zachary D. Hyde, & Luis A. Ruedas, [ruedas@pdx.edu](mailto:ruedas@pdx.edu), Department of Biology, Portland State University

The deer mouse, *Peromyscus maniculatus* (Rodentia: Muridae) was examined by molecular analysis of populations across high elevation habitats in Oregon and southern Washington. Maximum likelihood, Bayesian, and Maximum Parsimony tree estimation methods were used, along with TCS haplotype analysis, in order to infer relationships among individuals and sample localities. Genetic variation revealed patterns consistent with a climatic history of periodic fluctuations. There exist two distinct phylogroups in southern Oregon: one is distinct from those elsewhere in Oregon by 3.8% sequence divergence and pairs closely with *P. sejugis* from islands off of Southern Baja California. These data are concordant with numerous taxa that recolonized northward following the retreat of the Pleistocene ice sheets. The topologies resolved from our data supports a peripheral isolates model of speciation through range retraction and subsequent range extension from several distinct sources. These data suggest that the Pleistocene recolonization of the Pacific Northwest (PNW) did not equally favor the source populations of these recolonizations. Our data further suggest that the current taxonomic understanding of the *P. maniculatus* species complex, does not reflect biological reality, and that there in fact exist cryptic morphospecies throughout the range of this complex mammalian assemblage.

SALINITY TOLERANCE OF ANNUAL KILLIFISH EMBRYOS AND ASSOCIATED CELLULAR ADAPTATIONS, Ben E. Miller, [bemiller@pdx.edu](mailto:bemiller@pdx.edu), Dr. Jason Podrabsky, [jpod@pdx.edu](mailto:jpod@pdx.edu), Biology Department, Portland State University

In adult teleost fish, osmoregulation is accomplished primarily in specialized gill “mitochondria-rich cells (MRC)” that either excrete or uptake ions via active transport. Embryonic ion regulation involving specialized MRCs has been determined in two euryhaline species of teleost fish. The purpose of this study is to determine the tolerance of a developing freshwater annual killifish, *Austrofundulus limnaeus* to high salinity environment and to investigate the mechanisms of resistance. The development of *A. limnaeus* includes metabolically quiescent states known as diapause. Diapause may occur at two distinct stages of development and is associated with increased tolerance to environmental insults. During diapause II, 78%, 60% and 17% of the embryos survive for 20 days in 35, 50 and 70 ppt (parts per thousand) salinity, respectively. Post-diapause II embryos develop rapidly and at 4 days post-diapause II (dpd) embryos exposed to 35 and 50 ppt for 20 days show 15% and 10% survival, respectively. At 8 dpd the embryos have 12% and 3% survival in 35 and 50 ppt respectively. Finally during diapause III at 24 dpd only 7% and 0% of the embryos survive for 20 days in 35 and 50 ppt, respectively. Thus, salinity tolerance is high in diapause II embryos and nearly lost during post-diapause II development. The capacity for active transport of ions via Na<sup>+</sup>-K<sup>+</sup>-ATPase and H<sup>+</sup>-ATPase enzymes and the relative water permeability of embryos was determined during development. Results indicate that *A. limnaeus* embryos resist salinity stress by decreasing the permeability of the outer membrane rather than actively expelling ions.

MORPHOLOGY AND SYSTEMATICS OF SOUTHEAST ASIAN RHINOLOPHUS BATS, Lorelei E. Patrick, [lorelpatrick@gmail.com](mailto:lorelpatrick@gmail.com), Zack Hyde, Luis Ruedas, Department of Biology, Portland State University

*Rhinolophus* is a diverse genus of bats distributed throughout the Old World. Numerous species in the genus as currently recognized appear to be distributed across physical and geographic barriers that theoretically should serve as boundaries to gene flow. One case in point are the *Rhinolophus* on the island of Sulawesi in Indonesia. Sulawesi is an oceanic island that has never been in contact with other landmasses. It is improbable that small, weak flyers—as are most rhinolophid bat species—could regularly disperse to and from Sulawesi and thereby maintain gene flow between Sulawesi and other, distinct and distant island populations. We therefore hypothesize that *Rhinolophus* species found on Sulawesi are distinct from those found elsewhere in Southeast Asia. To test this working hypothesis, we compared putative *R. arcuatus* from Lore Lindu National Park, in Central Sulawesi, to bats from other islands in Southeast Asia as well as *R. arcuatus* from the type locality, the

Philippines. Principal component analysis was used to compare sixty morphological measurements taken from the specimens in question. To further test our hypothesis, we sequenced the mitochondrial Cytochrome b and control region genes for the same individuals and compared the sequences among each other and previously published sequences. Our results indicate that the species *Rhinolophus arcuatus* needs to be revised as it seems to contain at least one cryptic species. Given the geographically restricted nature of the current research, we strongly support the need for further study in this biogeographically complex taxon and region.

OUABAIN CARDIOPROTECTION IS MEDIATED BY RECEPTOR INTERNALIZATION AND MITOKATP OPENING, Casey L. Quinlan\*, [caseyq@pdx.edu](mailto:caseyq@pdx.edu), Abraham Rissa, Jana R. Burton, Alexandre D.T. Costa, and Keith D. Garlid, [garlid@pdx.edu](mailto:garlid@pdx.edu), Department of Biology, Portland State University

The Na<sup>+</sup>/K<sup>+</sup>-ATPase, or sodium pump, is a ubiquitous cellular membrane protein best known for its ability to couple the hydrolysis of ATP to the transport of Na<sup>+</sup> and K<sup>+</sup> across the cellular membrane. Its role in the maintenance of osmotic balance and membrane potential are crucial for cell function and survival. It has recently been discovered that the sodium pump also functions as a signal-transducing receptor for ouabain and other cardiotonic steroids. Recent studies suggest that this interaction stimulates a signaling event that results in protection from myocardial infarction (heart attack). In this study, we investigate the hypothesis that this cardioprotective effect is mediated via sequestration of the sodium pump and associated kinases into a signaling platform that internalizes and opens the mitochondrial ATP-sensitive K<sup>+</sup>-channel (mitoK<sub>ATP</sub>). We describe a procedure in which hearts are perfused with ouabain in a Langendorff apparatus. Following perfusion, mitochondria are isolated and subjected to purification in a Percoll density gradient. This yields a low-density fraction (henceforth termed the light-layer) and a purified mitochondrial fraction. As determined by western blot analysis, the light-layer contains caveolin, the sodium pump, and Src kinase as well as other proteins. We find, through observed changes in mitochondrial matrix volume, that addition of the light-layer to untreated mitochondria opens mitoK<sub>ATP</sub> similar to pharmacologic K<sup>+</sup>-channel openers such as diazoxide. From this data, we conclude that the light-layer from ouabain-perfused hearts contains a cardioprotective signaling platform that migrates to mitochondria and opens mitoK<sub>ATP</sub>, resulting in a protected state.

A WALK ON THE WILD SIDE: EVOLUTION OF ORDER XENARTHRA MODALITY DISTINCT FROM ALL OTHER MAMMALS, Barbara J. Shaw (edmunds@pdx.edu), Luis A. Ruedas (ruedas@pdx.edu), Department of Biology, Portland State University

The mammalian Superorder Xenarthra—formerly Order Xenarthra, split into: 1) Order Pilosa including anteaters, ground and tree sloths, and 2) Order Cingulata including glyptodonts, pampatheres and armadillos—are hypothesized to have been derived from a single common ancestor in the Neotropics because of an abundance of unusual and exclusive characteristics when compared to other mammals. The fossil *Ernanodon antelios*, of the Paleocene of China, has been attributed to Xenarthra. This is startling since there are no Old World xenarthrans; that hypothesis therefore requires a high degree of explanation. Xenarthrans are remarkably diverse, ranging from fossorial to hanging arboreal modes of life. The biomechanics of this group also are bizarre. This is the only taxon of mammals that possess a unique structure on their vertebrae: a xenarthrous articulation (doubly articulated vertebrae, vs. remaining mammals' single articulation). All Xenarthra—except glyptodonts—have xenarthrous articulations. All have a solid pelvis, with the transverse process of the caudal vertebrae fused to the ischium. For this project, twenty-three measurements from a total of 314 specimens representing 39 species were analyzed using Principal Component Analysis to examine the variability among families and within genera, and the results were then compared to 19 eutherian, 1 metatherian and 1 prototherian species of mammals, together with the fossil *E. antelios*. The results group all Xenarthra together while all other mammals, including *E. antelios*, are separately grouped. This lends support for excluding *E. antelios* as a xenarthran, and for the evolution of unique locomotory modality in Xenarthra.

## Undergraduate Student Posters

FACTORS DETERMINING ENTRY INTO DIAPAUSE II IN THE ANNUAL KILLIFISH, *AUSTROFUNDULUS LIMNAEUS*, Zac F. Kohl (zkohl@pdx.edu), Jason E. Podrabsky (jpod@pdx.edu), Department of Biology, Portland State University

The annual killifish *Austrofundulus limnaeus* produces embryos that enter diapause at approximately 24 days post-fertilization at 25°C. However, under laboratory conditions some breeding pairs of fish have been observed to produce a high percentage of embryos that bypass this stage of diapause. The mechanisms that regulate entry into diapause are currently unknown. We attempted to establish inbred lines of *A. limnaeus* that produce large quantities of bypassing embryos. To accomplish this goal we isolated two mating pairs that produced near 100% bypassing embryos. We then bred the progeny of these two pairs together as the F1 generation. The F1 generation did not show any substantial enrichment for fish that produced

embryos that bypass diapause. In addition older females tend to produce a higher percentage of embryos that enter diapause II compared to younger females. We were able to isolate a single breeding pair of fish from the F1 generation that produced nearly 100% bypassing embryos (1 out of 18 pairs). The production of bypassing embryos by the female from this pair was not altered by spawning with different males. The progeny of the F1 female that bypassed diapause are currently being bred as the F2 generation. Data from these fish again indicates a lack of selection for production of embryos that bypass diapause. We hypothesize that diapause II in *A. limnaeus* is regulated by cytoplasmic transmission through maternal provisioning.

## **EARTH AND ENVIRONMENTAL SCIENCE**

### **Graduate Student Posters**

USE OF INSECT REMAINS TO RECONSTRUCT PALEOENVIRONMENTAL CHANGE IN THE NORTHERN WILLAMETTE VALLEY, OREGON, Martin E. Adams, meadams@pdx.edu, and Virginia Butler, Department of Anthropology, Portland State University

Insect remains from a late-Pleistocene to early-Holocene peat deposit were extracted and analyzed to track climatic and environmental change in the Willamette Valley. With a basal radiocarbon date of  $11,600 \pm 130$  BP ( $13,150 - 13,870$  calibrated BP) and a probable Mazama tephra layer near the surface, this sample represents a record of over 6,000 years of environmental history. The Mutual Climatic Range (MCR) method is employed, which has been used extensively over the last decade in England, Canada, Scandinavia, and Greenland but rarely in the United States. Preliminary reconstructions of temperature in the Willamette Valley are presented, which should supplement previous botanical proxies by providing a quantitative estimate of temperatures over time. These reconstructions should prove more accurate than those of botanical proxies because insects respond more quickly to environmental change than plants, and should provide very precise measurements of the timing and magnitude of the Younger Dryas. Furthermore, by contributing to understanding paleoenvironmental history, the insect record has important implications for regional archaeology during this early period of human occupation of the Pacific Northwest.

QUANTIFYING CHANGE AT SEVEN GLACIERS IN THE SIERRA NEVADA, CALIFORNIA, Hassan J. Basagic\*, basagic@pdx.edu, and Andrew G. Fountain, andrew@pdx.edu, Department of Geography, Portland State University

The Sierra Nevada of California form a mountainous spine over 600 kilometers providing a vital source of California's water supply and contain numerous small high-elevation (~3500 m) alpine glaciers.

Alpine glaciers have shrunk in area and volume over the past century, which can be observed through the comparison of repeat photography. While knowledge of glacier shrinkage is common, there is little quantitative information on the magnitude or the rate of this reduction.

First, we conducted a map-based inventory of glaciers to define their population and extent. Our inventory of glaciers and perennial ice features throughout the range yields over 800 features with an area greater than 0.01 km<sup>2</sup>, yielding a total area of 34.8 km<sup>2</sup>. Additionally, we identified over 800 ice features with areas smaller than 0.01 km<sup>2</sup>. Secondly, to quantify changes in surface area over the past century, we reconstructed the extents of seven glaciers based on historic ground-based and aerial photographs, historic maps, and field measurements collected in 2004. All seven glaciers decreased in area over the past century ranging between 31 and 78%, an average of 51%. The differences in spatial changes appear to be related to local topographic controls that include differences in elevation and aspect, as well as differences in incoming solar radiation.

USING WEST HILLS, PORTLAND TO CHARACTERIZE THRESHOLDS FOR LIDAR MAPPING LANDSLIDES, Marina C. Drazba, [mcdrazba@pdx.edu](mailto:mcdrazba@pdx.edu), and Scott Burns, [burnss@pdx.edu](mailto:burnss@pdx.edu), Department of Geology, Portland State University

The West Hills of Portland, Oregon are prone to landslides because soil (loess) overlying basalt on steep slopes. The geology coupled with high levels of precipitation during the winter and parts of spring lead to high numbers of slope failures. Landslide indicators are hard to distinguish on traditional aerial photographs or satellite imagery due to extensive vegetation. We attempted to define large-medium-small landslides in the West Hills, Portland using LIDAR, which penetrates the vegetation for a view of the ground surface. We created contour lines with different intervals (5, 15, 50 feet) and compared the number of landslides identified in each. We also measured the area of each landslide. The 5 foot contour lines draped over a shaded relief landscape provided the best perspective for outlining landslides. However, the 50 foot contour intervals worked best for larger slides in areas that are heavily populated where it was difficult to discern the housing complexes with disturbed slopes.

NUMERICAL MODEL CALCULATING MELT-WATER PRODUCTION ON CANADA GLACIER, TAYLOR VALLEY, ANTARCTICA: IMPLICATIONS FOR ECOSYSTEM STABILITY, Jonathan Ebnet<sup>1</sup> ([ebnetj@pdx.edu](mailto:ebnetj@pdx.edu)), Andrew Fountain<sup>1</sup>, ([andrew@pdx.edu](mailto:andrew@pdx.edu)), Glen Liston<sup>2</sup>, Department of Geology, <sup>1</sup>Portland State University, <sup>2</sup>Colorado State University

A numerical model has been developed to calculate the volume of melt-water from glaciers in Taylor Valley, one of the McMurdo Dry Valleys, Antarctica (77°00'S 162°52'E). The dry valleys are the largest relatively ice-free region in Antarctica. Glacial melt-water is important in Taylor Valley since the ephemeral, melt-water streams

that flow from the termini of these glaciers are the main source of water and nutrients for perennially, ice-covered lakes that occupy the valley bottom. Small changes in melt-water production can have significant effects on life in this desert ecosystem. This model uses measured meteorological variables obtained from stations located on several glaciers. The model calculates surface and subsurface ice temperatures, total surface mass loss, and melt-water. Subsurface melt-water is important because austral summer air temperatures rarely exceed 0°C, suggesting that melt-water production has significant contributions from below the ice surface.

Preliminary results show that the numerical model predicts ice temperatures and total surface mass loss (sublimation/melt-water) well. Results show that from 1998 through 2005, the model predicts total surface mass loss with an 11% error. From 2002 through 2005, the model predicts subsurface ice temperatures at 50cm and 100cm depths with 4% and 5% errors respectively while from 2004 through 2005, the model predicts subsurface ice temperatures at depth in 25cm increments with errors ranging from 6% to 7%. This model will be applied over the melting area of a glacier in an attempt to reproduce the stream flow measured at the base of the glacier.

**DEFORESTATION AND DROUGHT: DID CLIMATE CHANGE PLAY A ROLE IN THE DEMISE OF EASTER ISLAND CULTURE?** Candace Gossen, [www.solar783.com](http://www.solar783.com), and M. Aslam Khalil, Dept. of Environmental Science and Resources, Portland State University

In recent years there has been a growing concern that human activities will cause global environmental changes that would be detrimental to our lives and society. It is well known that in historical and pre-historical times climatic changes have played an important role in the development of society and at other times it has posed severe constraints. These past human experiences with environmental change, whether caused by our own actions or not, may be lessons for understanding and dealing with our present problems. One of the best-known cases of societal collapse attributed to exceeding natural resources is the case of Easter Island, otherwise known as Rapa Nui. The reasons for the collapse are still being contested. The role of climate change has been suggested, but neither proven nor estimated. We have embarked on a multi-proxy research design that will determine whether climate change was a significant factor on the island and if deforestation and drought were more than mere coincidence.

**TWENTIETH CENTURY CHANGES IN PERENNIAL ICE FEATURES, ROCKY MOUNTAINS, COLORADO, USA.,** Matthew Hoffman, (hoffman@pdx.edu), Andrew Fountain, (andrew@pdx.edu), Departments of Geology and Geography, Portland State University

The Rocky Mountains of Colorado contain 141 features mapped as glaciers or permanent snowfields by the US Geological Survey in the 1950s. These perennial ice features have a total area of 4.8 sq. km

and are locally important to streamflow in late summer. The largest of these reside in the Front Range and are clearly active glaciers, while most features in Colorado would not be classified as glaciers by most definitions. We have developed a chronology over the last century for the perennial ice features of Colorado, with emphasis on the Front Range and Rocky Mountain National Park. Past feature extents have been delineated based on aerial photographs, historic maps, and ground-based photos and compiled in a Geographic Information Systems (GIS) database. Despite their small size, the perennial ice features of Colorado are surprisingly persistent and are relatively insensitive to changes in climate. Most features occur in east- to north-facing cirques at high elevations near the ridge crests. These locations favor snow accumulation from avalanches and windblown snow in the winter and are well-protected in shade from summer sun. These small, “drift” type glaciers are below the regional equilibrium line altitude and generally experience positive or negative mass balance over the entire feature in a given year. For this reason, they can exhibit high year-to-year variability in area, with 20% variations observed in consecutive years.

This analysis reveals a weak climate signal from these perennial ice features with respect to precipitation and temperature. The reliance of these features on windblown and avalanched snow for accumulation may make them more sensitive to changes in wind patterns than to precipitation and temperature.

ASSESSING AIR QUALITY IMPACTS OF AN URBAN FREEWAY IN PORTLAND, OR WITH SPATIALLY INTENSIVE MONITORING AND DISPERSION MODELING, Matthew Mavko, [mavko@pdx.edu](mailto:mavko@pdx.edu), and Linda A. George, [georgel@pdx.edu](mailto:georgel@pdx.edu), Environmental Sciences and Resources/Center for Science Education, Portland State University

While the Portland-Vancouver airshed is generally cleaner than many urbanized areas, traffic-induced air pollutants are a cause for concern in many neighborhoods adjacent to freeways. The air quality impact of urban freeways has been difficult to evaluate at the neighborhood scale because of the cost of making measurements at the necessary spatial intensity. Because of this, dispersion models are often used as surrogates. However, an accurate description of the emission rate of pollutants from roads using current methods is difficult in areas where researchers know little about the vehicle fleet. In this study we introduce an alternative method of calculating emission rates based on nitrogen dioxide measurements. Nitrogen dioxide is emitted in combustion exhaust and can be considered an indicator species for combustion-related pollution. Based on the methods of Palmes, et al. (1976) and several more recent studies, we describe a method of constructing and deploying low-cost NO<sub>2</sub> passive diffusion sensors. Laboratory calibration of our diffusion tubes shows excellent agreement (+/- 5%) with a continuous chemiluminescence monitor. Several field studies were conducted with these tubes. We modified CALINE4, a line dispersion model often used for urban pollution

assessment, to use these field measurements to back-calculate emission rates. Our I-5 studies indicate that there are above-background levels of NO<sub>2</sub> to the west and even higher levels to the east of I-5 in North Portland. Our model results indicate an emission rate of 2.5-3.5 grams NO<sub>2</sub> per vehicle-mile, consistent with values derived by the Oregon Department of Environmental Quality.

**CHARACTERIZING THE EFFECTS OF TURBULENCE ON PASSIVE DIFFUSION SAMPLING METHODS USING A CFD MODEL, Jeremy Parra, Dept. of ESR/Physics, Gerry Recktenwald and Linda George, CSE and Dept. of Environmental Sciences/Resources, Portland State University**

The passive diffusion sampler first developed as a personal air toxic sampling device (Palmes et. al, 1973) designed to be worn in a workplace has found wide use in environmental air quality measurements. The diffusive sampler can be used to measure several air pollutants: nitrogen oxides, sulfur dioxide, ammonia, VOCs, and ozone (Brown, 1993). Several groups have shown that high wind speeds ( $> 2 \text{ m s}^{-1}$ ) cause a decrease in diffusion length leading to an overestimation in ambient concentrations (Plaisance 2004, Varsheny 2003, Kirby 2000). Here a computational fluid dynamics model (CFD) is employed to quantify the reduction in diffusion length within passive diffusion samplers caused by air flow across the mouth of the sampler. The model was used to determine the relationship between the sample rate of a Palmes-type diffusion sampler and wind speed and was successful at reproducing the quadratic relationship empirically determined by other researchers. Having verified the utility of CFD to predict experimental results, we will investigate the effectiveness of mitigating structures (e.g. protective shelters and Teflon wind barriers) to improve sensor performance. Results from these studies suggest that CFD is an accurate and cost-effective approach for assessing diffusive sampler design and performance.

**INFLUENCES OF TEMPERATURE OBSERVED IN THE NORTH FORK JOHN DAY RIVER, CENTRAL OREGON, Christopher J. Sheridan (csheri@pdx.edu), Michael L. Cummings, cummingsM@pdx.edu, Christina L. Hulbe, and Robert B. Perkins, Department of Geology, Portland State University**

The John Day River is situated in Central Oregon and is recognized as one of the few remaining free flowing fluvial systems in the Pacific Northwest. The North and Middle Forks combine to produce approximately 73-82% of the fish population within the John Day system, which is recognized as containing the largest spawning population for wild spring Chinook salmon and summer steelhead remaining in the Columbia River system (USFW 2002). High temperatures have a negative impact on this important habitat and have been observed within the North Fork during summer months using forward looking infrared (FLIR) imaging. This project attempts to gain insight regarding the sources of temperature input to

the system and relative significance of each source. The analysis uses a multi-disciplinary approach, constraining the water-budget of the system during a time interval of approximately 7 days during summer base flow. Data from concurrent temperature observation will be compared with the water-budget model to make inferences as to the sources of observed temperature.

USFW (2002). U.S. Fish and Wildlife Service, Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. O. John Day River Recovery Unit. Portland: Ch. 9.

POLAR ICE CLIFF DYNAMICS, TAYLOR GLACIER, MCMURDO DRY VALLEYS, ANTARCTICA, Sniffen, Peter J<sup>†</sup>, [pshiffen@pdx.edu](mailto:pshiffen@pdx.edu), Pettit, Erin C\*, Fountain, Andrew G\*\*, [Andrew@pdx.edu](mailto:Andrew@pdx.edu), and Hallet, Bernard\*

† Portland State University; Department of Geology

\* University of Washington; Department of Earth and Space Science

\*\* Portland State University; Department of Geology, Department of

#### Geography

Rapidly retreating tidewater glaciers, which exhibit high flow velocities and calving rates, lose most of their mass through the calving of icebergs and have received significant attention in studies of climate change. Because of the difficult and dangerous nature of studying a calving tidewater margin however, the dynamics that drive calving events are poorly understood. Glaciers such as those found in the McMurdo Dry Valleys, Antarctica are accessible, have low flow velocities, and still demonstrate a calving front. Studies of the glaciers of the dry valleys will give further insight into the nature of glacier calving events.

In 2003 and 2004, five surface stake arrays and two cliff arrays were installed on the lower Taylor Glacier, an outlet glacier of the East Antarctic Ice Sheet located in the Taylor Valley, Antarctica. Stakes in these arrays were surveyed to reveal motion data for the interior and terminus of the glacier. Preliminary results show stake velocities of approximately  $1.5 \text{ myr}^{-1}$  in the down-glacier flow direction and  $2.1 \text{ myr}^{-1}$  in the cliff-ward direction. Down-glacier flow velocities are shown to decrease with proximity to the cliff edge. Ablation measurements at the cliff sites show summer season ablation values from 50-100 cm compared to surface ablation values of 15 cm. Based on field observations and the surface velocities measured near the terminal cliff, these data suggest that ablation plays a large role in maintaining the morphology of the terminus. In addition, stake motions show differential ice flow in some locations close to the terminal cliff.

EFFECT OF URBANIZATION ON AIR AND SOIL TEMPERATURES IN THE PORTLAND METROPOLITAN AREA, Claire Steiner, [csteiner@pdx.edu](mailto:csteiner@pdx.edu), Kelley Martin, Kristin Schou, Candice Holcombe, Ali Sadiq, Jeremy Parra, Dr. Linda George, [georgel@pdx.edu](mailto:georgel@pdx.edu), Center for Science Education, Portland State University

The Urban Heat Island effect has been studied extensively in relation to air temperatures, but few researchers have examined the effect it has on both air and soil temperatures. Increased soil temperatures in urban areas can adversely affect root growth, soil organism productivity, foraging animals, and inorganic chemical processes. This study examines nighttime surface-level soil and air temperatures in the Portland, Oregon, metropolitan region in relation both to distance from the Portland urban center and to local levels of urbanization at the measurement sites. Measurements were taken in the early morning hours of November 19, 2005. Soil and air temperatures were measured at one-mile intervals along a 15-mile transect beginning in the Portland urban core and extending south-southeast to approximately three miles beyond the urban growth boundary. The study found a general increase in soil temperatures both with proximity to the urban center and with increasing levels of impervious surfaces associated with local urbanization. Soil temperatures at the urban core were found to be an average of 2.4 degrees Celsius higher than coinciding soil temperatures outside the urban growth boundary. Along the urban-to-rural transect, soil temperatures correlated more strongly with local levels of urbanization than with distance from the urban core. This study shows that urbanization, both local and regional, influences both surface-level soil and air temperatures.

SLOPE STABILITY CONCERNS AT THE PARKIN QUARRY, WASHINGTON COUNTY, OREGON, Joshua Theule, [jtheule@pdx.edu](mailto:jtheule@pdx.edu), Margaret Russell, and Dr. Scott Burns, [burnss@pdx.edu](mailto:burnss@pdx.edu), Department of Geology, Portland State University

An earthflow occurred during heavy rains at the Parkin Quarry. The earthflow event initiated an engineering geologic evaluation of the failure and the existing quarry area. Preliminary earthflow mitigation measures and slope stability concerns encountered in the quarry were evaluated. The basis for the geologic mapping was an aerial photo and new topography prepared at 2 foot contours. The Parkin Quarry is located on the eastern flank of a northwesterly plunging anticline. The quarry extracts diabase sill within shales associated in the Eocene. The sill and shale dip out of slope 45 to 55 degrees. Placement of the fills were in a small drainage above the quarry highwall. Heavy rains in December 2005 triggered the failure of the fills, the earthflow flowed down the canyon and onto an adjoining neighbor's property. A preliminary evaluation indicated that the existing fills and earthflow materials will need to be stabilized. By extracting the diabase sill in the quarry, portions of the shale have been destabilized located behind the sill. The stability of the shale

and diabase vary due to the variations of weathering, dip slope of the shale, and the steep cut into the slope. Preliminary stability analysis was performed on the shale. To stabilize the existing highwall will either entail, flattening of the highwall slopes or placement of fills in the quarry to buttress the existing highwall slope. Additional engineering geology and geotechnical evaluation may be needed depending on the final configuration of the quarry desired by the owner.

REAL-TIME MEASUREMENTS OF DIESEL PARTICULATE MATTER USING A CAVITY RING-DOWN TRANSMISSOMETER, Monica Wright\* ([wrightm@pdx.edu](mailto:wrightm@pdx.edu)), Linda A. George, Dean B. Atkinson ([atkinsond@pdx.edu](mailto:atkinsond@pdx.edu)), Department of Chemistry, Portland State University

A growing number of studies indicate that people who live in neighborhoods that are near highways or other high traffic areas have significantly higher health risks due to inhalation of Diesel Particulate Matter (DPM). Diesel particulate matter is particularly harmful because of its size distribution, morphology and chemical properties. More than 50% of the cancer risk due to air toxics in Portland, OR is due to exposure to DPM according to EPA model estimates. However, using conventional aerosol monitoring instruments, actual measurements of DPM levels is difficult due to the challenge of isolating DPM from other particulate matter in polluted air. Our real-time instrument, which employs both the Cavity Ring-Down technique and a commercially available nephelometer, is capable of effectively assessing DPM levels by measuring the optical properties of air. Our instrument is capable of measuring the absolute optical extinction and light scattering of aerosols at the  $Mm^{-1}$  level. Taking the difference between the extinction and scattering yields a measure of the absorption characteristic of the sampled air. The single scattering albedo, an intensive measurement of the blackness of a particle, can also be determined. Given that diesel exhaust is known to contain small, highly absorbing nanoparticles, we expect that the measurement of absorption should be highly correlated with DPM concentrations, while the single scattering albedo should be useful in following the mixing/dilution of the DPM as the distance from the source is increased. Validation studies and recent results from an air measurement campaign in North Portland, Oregon suggest good correlation between our measurement and DPM levels.

## Undergraduate Student Posters

DEVELOPMENT OF A GROUNDWATER FLOW MODEL FOR THE WILLIAMSON RIVER BASIN, Scott B. Braunsten, [jodax@comcast.net](mailto:jodax@comcast.net), Christina L. Hulbe, [chulbe@pdx.edu](mailto:chulbe@pdx.edu), Department of Geology, Portland State University

The Williamson River basin, the northernmost catchment in the Upper Klamath Basin, has a groundwater system that is of interest for its connections to local and global ecosystem, and agricultural water

requirements. Modeling groundwater flow within the aquifer will help with determining the water budget for the basin. The first step in this effort is development of a model domain. This is a process that must merge a range of primary data sources into one internally consistent and useful framework. Maps of surficial geology, prior depositional process studies, and sparsely distributed water well logs of varying quality and detail are involved in that process. The data are then placed into the GMS 6.0 groundwater modeling program for generation of a simplified stratigraphic representation of basin geology, a necessary step in creating a viable representation of basin groundwater flow.

PRESENCE OF DIATOMS IN GEOTHERMAL SPRINGS, MICKEY HOT SPRINGS, SOUTHEASTERN OREGON: IMPLICATIONS FOR PALEOENVIRONMENTAL RECONSTRUCTION. Mary K. Dietrich and Dr. Scott Burns, [BurnsS@pdx.edu](mailto:BurnsS@pdx.edu), Department of Geology, Portland State University

Diatoms are photosynthesizing algae with a siliceous skeleton and are found in almost every aquatic environment. They are found in environments with extreme temperatures, ranging from ice cores to geothermal springs. Various bacteria, such as *Chloroflexus*, and *Synechococcus* have been extensively studied in geothermal settings, but few studies have focused on the presence of diatoms along geothermal gradients and their incorporation into sinter deposits along the borders of many springs. The bacterial community of Mickey Hot Springs, a geothermal springs in southeastern Oregon, has been previously investigated, but diatoms have not been included in these studies. Samples from bacterial mats of 8 sites in Mickey Hot Springs were collected, prepared, and examined by SEM techniques. Temperature range of the collection sites was 40° – 79°C; pH 7.32 – 9.0. Four genera with seven species of diatoms were identified and measured. Genera included *Criticula*, *Nitzschia*, *Rhopalodia* and *Gomphonema*. *Criticula* and *Nitzschia* were the most prevalent. Sites with higher relative diatom abundance had temperatures of 41° and 46°C, and alkaline pH. No diatoms were identified at the two sites with temperatures >75°C, the upper limit of temperature tolerance for photosynthesizing organisms. Numerous examples of the encrustation of diatoms with bacterial filaments and silica deposits were noted. Diatoms are easily incorporated into sinter fabric and may remain whole because of the great compressional strength of the diatom frustule structure. Because living diatom species have specific salinity, temperature and geochemical tolerances, it may be possible to use transfer functions to produce accurate paleoenvironmental reconstructions.

GLACIER BEHAVIOR AFTER ICE SHELF COLLAPSE IN CRANE GLACIER, ANTARCTIC PENINSULA, Amie Lamb [amie\\_k\\_lamb@yahoo.com](mailto:amie_k_lamb@yahoo.com), and Christina Hulbe [chulbe@pdx.edu](mailto:chulbe@pdx.edu), Department of Geology, Portland State University

The Antarctic Peninsula is the fastest-warming region on Earth, about 2.5°C over the last 60 years. Since the early 1990's, many changes have been observed in the Peninsula's glacier systems, presumably in response to that warming. One such change is the speed-up of Crane Glacier, which began in 2002, after the disintegration of the Larsen B Ice Shelf into which it had flowed. We use Landsat 7 and ASTER images to track ice displacement. Speeds in the downstream trunk of the glacier were significantly slower between 18 December 2002 and 20 February 2003 (summer) than speeds computed over the entire the 327-day period between 18 December 2002 and 13 January 2004. No significant differences were observed in the upstream region of the glacier. Calculated speeds due to internal deformation of the ice are significantly smaller than the observed speeds. Together, these lines of evidence suggest that the glacier is sliding over its bed during at least part of the year. The relatively slow summertime speeds (compared to the annual speed) may indicate that by this time in the melt season, the basal water system has become efficient, and basal water pressures a lower than at other times of the year. If this interpretation is correct, it suggests that in the absence of the Larsen B, Crane Glacier is behaving as a tidewater glacier, similar to large coastal outlet glaciers in Alaska and Greenland.

## **ENGINEERING, COMPUTER SCIENCE, AND MATH**

### **Graduate Student Posters**

MULTI-LAYERED ORGANIC LUMINESCENT DIODE (OLED) BASED BIO-SENSORS, Sandeep Devabhaktuni, [Sandeepd@Pdx.Edu](mailto:Sandeepd@Pdx.Edu), Sunil Kumar Penna, Sudhaprasanna Kumar Padigi, Shalini Prasad, Biomedical, Micro devices and Nanotechnology Laboratory, Portland State University

We have fabricated a multi-layered organic luminescent diode (OLED) for biomolecule/bioagent detection. This has been achieved by incorporating the techniques of organic light emitting diodes used for improved visual displays with bio-chemical functionalizing techniques. Bio-sensing using OLED'S is expected to demonstrate improved sensitivity, selectivity and speed of detection as compared to other bio-sensing methods that have been developed using the principles of micro and nanofabrication. The advantage this technique has over other methods such as laser spectroscopy, fluorescent tagging etc; it has very high efficiency due to improved electron-hole recombination, longer output displays due to reduced optical quenching and the ability to produce luminescence in the whole visible region.

The multi-layer OLED structure comprising of a sandwich of ITO—MEHPPV—AlQ3—Aluminum (cathode) coated on glass is fabricated using multi-level spin coating. Here the binding between OLED and bio-agent is achieved using enzyme-substrate based interactions. Applying forward bias voltage with respect to ITO, light is observed from 2.5V. The intensity of the light is measured with and without bio-agent. And finally examining the difference in intensity, the presence of the bio-agent is identified.

CYLINDRICAL OPTICAL WAVEGUIDE BASED DETECTION AND CHARACTERIZATION OF PROTEIN-ANTI PROTEIN BINDING EVENTS, Sudhprasanna Kumar Padigi<sup>1</sup>, Kofi Kasaante<sup>2</sup>, [Vijay Sekhar Reddy Kovvuri](#)\*<sup>1</sup>, Ravi Kiran Kondama Reddy<sup>1</sup>, Andres LaRosa<sup>2</sup>, Shalini Prasad<sup>1</sup>, Department of Electrical and Computer Engineering, <sup>2</sup>Department of Physics, Portland State University

We have developed a micro-phonic cylindrical waveguide for the detection and characterization of protein-anti protein binding. The cylindrical waveguides were fabricated using standard photolithography on photo-sensitive polymer. We have characterized the device using 632.8nm red laser. The waveguide was excited through an etched silica fiber tip. The measurement system comprised of lock-in amplifier and a chopper for providing the reference. The proteins that were characterized were: CRP-AntiCRP, MPO-AntiMPO. These proteins are very useful in the early bed detection of vulnerable plaque that leads to fatality in post operative scenario. The response time of the sensor is on the order of milli seconds. These sensors were tested for a concentration of 10ng/ml. The experiments were repeated for n = 3 times, to establish repeatability and robustness in the detection process.

INVARIANCE PRINCIPLE FOR ACTIVE SONAR SYSTEMS, Jorge E. Quijano ([jorgeq@pdx.edu](mailto:jorgeq@pdx.edu))\*, Dan Rouseff, Lisa M. Zurk ([zurkl@cecs.pdx.edu](mailto:zurkl@cecs.pdx.edu)), Dept. of Electrical and Computer Eng., and Northwest Electromagnetic and Acoustics Research Laboratory, Portland State University

The propagation of broadband acoustic waves in shallow water channels is a complicated phenomenon which depends on the attributes of the water column and bottom structure. It has been shown that the time-frequency structure resulting from this propagation can be explained with the principle of a waveguide invariant and that this description does not require precise knowledge of the propagation environment. The invariance principle has been successfully applied to passive sonar geometries where the acoustic wave travels a single path between the source and the receiver, but little work has been done for active sonar applications in which the acoustic wave follows a bistatic path.

In this paper we present experimental results which demonstrate the effect of the bistatic invariance principle for active sonar systems. The broadband sonar data was collected as part of the Shallow Water

Active Detection/Classification (SWAC) project in the Malta Channel area. Analysis of the frequency components of the returned signal revealed the presence of striation patterns similar to those found in passive sonar lofargrams and information about the trajectory of the moving target could be extracted. A new mathematical expression has been derived to describe the invariant in active sonar geometries, and the expected structure depends on the scattering properties of the target in addition to the group velocity and speed profile of the channel. The identification of a bistatic invariant will allow the implementation of robust processing methods and decrease the complexity of tracking algorithms.

BIOCHEMICAL SENSOR/ GAS BASED FOR DETECTION OF ENVIRONMENTAL CRITERIA POLLUTANTS, Hasan Shariare, [shariare@pdx.edu](mailto:shariare@pdx.edu), Shalini Prasad, ECE Department, Portland State University

Air quality monitoring is of primary importance for improved human health. Monitors that are portable inexpensive, selective and sensitive are essential in applications such as monitoring the effluents from industrial chemical processes (e.g., petrochemicals, hydrocarbons, nitrogen dioxide, ammonia, hydrogen, oxygen, carbon monoxide, carbon dioxide, methane, hydrogen sulfide) and monitoring of environmental pollutants. The global objective of this project is to develop a gas based sensor for detection of environmental criteria pollutants. This is to be achieved by utilizing the capability of hollow nanomaterial to trap a varied species of gas molecules. The binding event associated with the trapping of the gaseous agent with the surface functionalized nanomaterial results in a modulation to the electrical conductance. This forms the basis of gas detection. The objective of this particular application is to evaluate hollow nanomaterial to identify the optimum material for sensing.

Nanomaterial based gas sensors can be key devices in the call for the development of low-cost sensing elements and low-power consumption devices. The large surface areas available for molecule adsorption make hollow nanomaterial suitable for sensors. Different types of nanomaterial such as single-walled carbon nanotubes and multi-walled carbon nanotubes can be used for gas sensing. Such sensors will provide a high sensitivity, fast response, long lifetime and low detection thresholds for different analytes. Moreover, The  $\text{Co}_3\text{O}_4$  nanotubes exhibit excellent sensitivity to hydrogen and alcohol, owing to their hollow, nanostructured character.

INCIDENT DATA REPORT - EVALUATION OF PORTLAND REGION'S INCIDENT MANAGEMENT (COMET) SYSTEM FOR THE YEAR 2005, Suman Tasnim, [tasnims@cecs.pdx.edu](mailto:tasnims@cecs.pdx.edu), and Robert L. Bertini, [bertini@pdx.edu](mailto:bertini@pdx.edu), Department of Civil & Environmental Engineering and School of Urban Studies and Planning, Portland State University

In the modern day economy, predictable and regular travel times have a high priority for urban travelers and businesses. Crashes,

vehicle breakdowns, weather, special events, construction and maintenance activities affect the reliability of transportation systems. These events more often referred to as incidents occur in our highway system reducing the capacity of our roads and causing congestion if the traffic demand exceeds the reduced capacity at the incident location. Prompt incident management is the key to the enhancement of the traffic operations and safety in our highways. The primary goal of an Incident Response (IR) team is to provide prompt response to incidents and clear roadways as quickly as possible in high volume area during peak traffic times.

The Incident Response (IR) program in the Portland Area, known as COMET (CORridor Management Teams) started in March of 1997. With the introduction of the COMET program the response time to incidents have seen a significant reduction and in turn has improved the operations and flow of traffic in Portland's highways. Using Incident data from ODOT this paper poster evaluate the effects that COMET program has on the response to incidents, delay and fuel consumption for motorists and reduction in environmental pollution. This paper includes a statistical analysis of the Incident Response Data to trace out trends in the incident occurrence so the IR program can use the results to help in resource allocation and prompt management.

IMPACT OF OBJECTIVE MODELS ON SEARCH-BASED PARALLEL COMPUTER JOB SCHEDULING, Sangsuree\* Vasupongayya, [vsang@cs.pdx.edu](mailto:vsang@cs.pdx.edu), Su-Hui Chiang, [suhui@cs.pdx.edu](mailto:suhui@cs.pdx.edu), Bart Massey, Computer Science Department, Portland State University

The problem of scheduling for high-performance parallel computer workloads typically involves several conflicting performance goals. The general multicriteria problems have been studied in many papers, and several optimization techniques have been proposed. However, it is not always obvious how to successfully apply these techniques to a specific problem. The multicriteria optimization problem for non-preemptive job scheduling—currently used on many production parallel systems—is particularly challenging.

In our previous work, we have constructed a multiobjective goal-oriented scheduling framework by designing an objective model and a scheduling policy based on combinatorial search techniques. This new scheduling framework enables system administrators to declaratively specify high-level performance goals, rather than tuning low-level scheduling parameters as required in priority-based schedulers adopted on many production parallel systems. Our initial study used a hierarchical objective based on two performance goals commonly placed on production parallel computers: avoiding any job from incurring an excessive wait and minimizing average job slowdown.

Our search-based scheduling policy was shown to simultaneously outperform two traditional scheduling policies, designed to minimize maximum wait and average slowdown, respectively. In addition, our

new policy achieves competitive fairness in job wait and bounded slowdown.

Recently, we have extended our hierarchical objective model to allow an explicit specification of performance tradeoff, e.g., a schedule S1 is considered an improvement over S2 if S1 improves a given performance metric in the objective more than it degrades other metrics, compared to S2. This poster reports the impact of these new and more flexible objective models on scheduling performance.

## **Undergraduate Student Posters**

PATTERN GROWTH OF CARBON NANOTUBES BUNDLES, Noel Tavan, [noelt@pdx.edu](mailto:noelt@pdx.edu), Dr. Jun Jiao, [jiaoj@pdx.edu](mailto:jiaoj@pdx.edu), Department of Physics, Portland State University

Materials made of carbon nanotubes (CNT's) are one of the most promising resources of the future. Their structure and electrical properties have generated increasing interest over the last decade. CNT's possess numerous characteristics that are unique and may be used in myriad applications such as flat panel displays where low cost, as well as high pixel definition, is required. However, much work remains to be done to determine the most efficient and reliable way to use them. Toward this end we have developed several test platforms using standard photo lithographic techniques. Each platform is based on a different pattern and is designed to test the electrical or mechanical characteristics of CNT structures. We will present electron microscopy analysis of several post-growth patterns as well as field emission data from CNT bundles contained within one of the platforms. The significance of patterned growth of carbon nanotubes in industrial applications will also be discussed.

## **CHEMISTRY AND PHYSICS**

### **Graduate Student Posters**

AN INTEGRATED APPROACH FOR PRODUCING NANOMETER RADIUS TUNGSTEN PROBES, Kofi Asante, Keith Parker and Andres La Rosa, Physics Department, Portland State University

We present an electronically controlled electrochemical etching method to fabricate metallic tips of nanometer diameters with high degree of reproducibility. The electronics comprises of a designed circuit that automatically switches off the etching current, and a microprocessor. The microprocessor is used to monitor and study current as a function of voltage for the etched tips thus enhancing their reproducibility. The tips produced are useful for near-field optical microscopy (NFO), scanning tunneling microscopy (STM), and shear-force/ultrasonic near-field microscopy (SUNM).

CORRECTION OF SPHERICAL ABERRATIONS WITH A GAUZE LENS, Aida Biberic, [aidab@pdx.edu](mailto:aidab@pdx.edu), Rolf Koenenkamp, and Gertrude Rempfer, Physics Department, Portland State University

Spherical aberrations are currently limiting factor in high-resolution electron microscopy. Introduction of an equipotential surface at the optical axis of the electrostatic lens can reduce the spherical aberrations. The equipotential surface is constructed by inserting an additional electrode with a thin copper mesh, partially transparent to electrons, at the optical axis of the lens. This lens is tested in a straight optical bench, with a thermionic electron source at one end and a phosphor coated fiber optics window at the other end. Spherical aberrations are measured using a shadowgraph technique. The experiment is also simulated by SIMION, an Ion and Electron Optics simulation software. Results suggest that aberration coefficient decreases when potential applied to the copper mesh is changed from  $-300$  V to  $+300$  V. This way of correcting aberrations may be introduced into already existing electron microscope systems for the overall improvement of the image resolution.

NANOCRYSTAL PHASE IDENTIFICATION BY LATTICE FRINGE FINGERPRINTING FROM HIGH RESOLUTION TRANSMISSION ELECTRON MICROSCOPE IMAGES, Ruben Bjorge<sup>1,\*</sup>, [rbjorge@pdx.edu](mailto:rbjorge@pdx.edu), Bjoern Seipel<sup>1,\*</sup>, Peter Moeck<sup>1,\*§</sup>, [pmoeck@pdx.edu](mailto:pmoeck@pdx.edu), Phil Fraundorf<sup>2</sup>, <sup>1</sup>Department of Physics, Portland State University, <sup>\*</sup> Oregon Nanoscience and Microtechnologies Institute, <http://www.onami.us>, <sup>2</sup>University of Missouri at St. Louis

Lattice fringe fingerprinting is a novel and powerful method of identifying and characterizing nanocrystalline structures or materials based on images from direct space high-resolution transmission electron microscopy (HRTEM). We examine Fourier transformed HRTEM images of nanocrystals in certain orientations (i.e. lattice fringes and cross fringes) in order to obtain a lattice fringe fingerprint plot. Such plots are used to identify a crystalline nanoparticle by comparing the experimental data with data that are derived from a comprehensive database. A lattice fringe fingerprint plot is similar to a classical X-ray powder diffractogram, but an important advantage is that the intersection angles of lattice fringes give us additional information. When transmission electron microscope image acquisition and data interpretation are automated and connected to a comprehensive database (such as our Nano-Crystallography Database, <http://nanocrystallography.research.pdx.edu>), fringe fingerprinting will be able to compete with powder X-ray diffraction in identifying unknown nanocrystals on a routine basis.

DISCOVERY AND CHARACTERIZATION OF A NOVEL NON-CANONICAL TYPE I GTP CYCLOHYDROLASE, Shilah A. Bonnett, [sabonnet@pdx.edu](mailto:sabonnet@pdx.edu), Dr. Dirk Iwata-Reuyl, [iwatard@pdx.edu](mailto:iwatard@pdx.edu), Chemistry Department, Portland State University

Transfer RNA is the most modified RNA within the cell. Modifications are an integral part of tRNA maturation and occur post-transcriptionally at the level of the tRNA. In terms of chemistry and structure, archaeosine (G\*) and queuosine (Q) are two of the most chemically complexed modified nucleosides identified in tRNA (Fig 2). Early feeding studies and radiochemical analysis have demonstrated that GTP is the metabolic precursor to Q and the initial conversion of GTP involves the loss of C-8, suggesting GTP cyclohydrolase like chemistry. There are three types of GTP cyclohydrolases all of which catalyze the hydrolysis of the C8-N9 bond resulting in the opening of the guanine ring. We are particularly interested in Type I GTP cyclohydrolase which is involved in folate and pterin biosynthesis. A gene clustering analysis was conducted to determine if the involvement of GTP cyclohydrolase is a viable hypothesis a gene. The results show that the gene encoding a Type I GTP cyclohydrolase clustered with known queuosine biosynthesis genes in many organisms. It was also discovered that the Type I GTP cyclohydrolase gene was locally missing in a number of organisms that contain queuosine and most importantly other folate biosynthesis genes. Comparative genomic analysis resulted in the identification of an uncharacterized gene, COG1469, with unknown function that followed the observed phylogenetic criteria. We report here the identification and characterization of a novel non-canonical Type I GTP cyclohydrolase

PRECIPITATION OF  $Zr_2Cu$  STABLE CRYSTALLINE PHASE FROM  $Zr_{70}Cu_{27.5}Rh_{2.5}$  METALLIC GLASS, David Cushman<sup>1,\*</sup>, Junji Saida<sup>2</sup> & Chunfei Li<sup>1</sup>, <sup>1</sup>Dept. of Physics, Portland State University, <sup>2</sup>Tohoku University, CIR, Sendai, Japan.

The crystallization process of  $Zr_{70}Cu_{27.5}Rh_{2.5}$  metallic glass was studied with transmission electron microscopy (TEM). In contrast to previous studies where the precipitation of metastable icosahedral quasicrystalline (IQC) particles was the main interest, we designed the present work to focus on the nucleation process of the stable  $Zr_2Cu$  crystalline phase. It has been found that the alloy consists of IQC particles distributed in the amorphous matrix prior to the precipitation of the  $Zr_2Cu$  stable crystalline phase, and  $Zr_2Cu$  nucleates from the amorphous matrix. Elemental analysis revealed that Cu is depleted and Zr is enriched in the IQC particles as compared with the amorphous matrix. The encounter of the IQC phase with  $Zr_2Cu$  transforms the former into the latter so quickly that no interface between them was found in the present experiment. These insights provide the basis for a discussion of the stability of metallic glasses and the IQC particles.

SINGLE-CRYSTALLINE ZNO NANOWIRES GROWN ON SI WAFER,  
Meirzhan Dosmailov, meirzhan@pdx.edu, R. Word and R. Könenkamp,  
Physics Department, Portland State University

Low-dimensional semiconductor nanostructures such as quantum wires and quantum dots are of interest for use as active components in various optoelectronic devices. Free-standing vertically arranged ZnO nanowires can be made in a variety of processes, including chemical vapor deposition, metal-organic vapor phase epitaxy and electrodeposition. Among these processes electrodeposition is the only low-temperature process that is compatible with glass and polymer substrates. We show that electrodeposition produces crystalline nanowires of excellent structural quality. Combining the optical properties of these nanowires and the electronic capabilities of silicon technology is of interest, since it may eventually enable inter-chip optical signal transfer. We show, for the first time, that ZnO nanowires can be grown on Si substrates and we report on the details of the growth conditions.

NONLINEAR TIME DEPENDENCE OF THE DARK COUNT IN CCDs,  
Ines Hartwig\*, ines.hartwig@s2002.tu-chemnitz.de, Ralf Widenhorn, and Erik Bodegom, Department of Physics, Portland State University

Time series of dark frames for charge coupled devices are analyzed. The results show that the dark count depends nonlinearly on the exposure time -- a fact that has so far been ignored by dark current correction methods. But especially for temperatures close to room temperature and exposure times of several minutes the effect becomes significant.

RESOLUTION AND CONTRAST OF AN ELECTRON LENS, Thomas Jones, [jonesthomasr@yahoo.com](mailto:jonesthomasr@yahoo.com), R. Word and R. Könenkamp, Physics Department, Portland State University

One of the great benefits of electron microscopy is the high resolution that can be achieved in comparison to light optics. However, lens aberrations still prevent to exploit the full potential of electron optics. We report a mathematical method to calculate the image properties of electron lenses when they are affected by chromatic and by spherical aberration. We use a method that is based on a wave-mechanical determination of the image intensity distribution by numerically integrating the relevant Fresnel integrals incorporating third order aberration effects. We use this method to determine the contrast, resolution and signal intensity, and we calculate the optical transfer function for the lens under various conditions.

MUTATIONAL AND KINETIC STUDIES OF THE NADPH DEPENDENT PREQ<sub>0</sub> REDUCTASE QUEF, Bobby W. K. Lee and Dirk Iwata-Reuyl, Department of Chemistry, Portland State University

The flow of genetic information from DNA to RNA to proteins constitutes the central dogma of molecular biology. At the interface

between RNA and protein, transfer RNA plays a critical role in the translation of messenger RNA and the delivery of the appropriate amino acid into the growing protein sequence. In the maturation of these molecules, transfer RNA undergoes extensive post-transcriptional processing; some of which chemically modify the genetically encoded bases of tRNA. Among these modified nucleosides, queuosine is perhaps the most structurally complex. The biosynthesis of queuosine involves multiple enzymatic steps, one of which is catalyzed by the novel nitrile oxidoreductase, QueF. The direct reduction of the nitrile functional group to an amine has not been previously observed in biology, and one of our aims is to understand the mechanisms involved in this process. Based on the sequence analysis of this protein family and comparison with enzymes catalyzing similar chemistry, we have proposed that a conserved cysteine residue acts as a catalytic nucleophile in this reaction. To ascertain whether this hypothesis is correct, we have carried out thiol inactivation, mutagenesis, and kinetic studies on the *B. subtilis* ortholog of QueF, YkvM. The results show that although this cysteine residue likely resides within the active site and plays a direct role in the reduction process, its presence does not appear to be critical for catalysis. Further studies to clarify the role of this residue include the chemical trapping of a covalent complex and the synthesis of a mechanism-based active site inactivator is described.

#### ELECTRON MICROSCOPY CHARACTERIZATION OF CARBON NANOTUBE BASED ELECTRICAL AND MECHANICAL TEST STRUCTURES, Devon McClain, Jun Jiao, Physics Department, Portland State University, Coralee McCarter, David Bahr, Cecilia Richards, Robert Richards School of Mechanical and Materials Engineering, Washington State Univ.

The potential for integration of carbon nanotubes (CNTs) into working devices has long been recognized. However, to realize this potential, test structures must be fabricated to evaluate critical parameters such as pattern geometry, growth orientation, catalyst density, etc. We present here a method for the controlled growth of CNTs in configurations suitable for mechanical, thermal and field emission testing. These structures display high pattern definition and uniform growth morphology.

CNT growth was achieved through chemical vapor deposition (CVD). A p-type silicon wafer (100) was etched for 30 seconds in Buffered Oxide Etch (BOE) to remove the native oxide layer. An iron nitrate (0.72M, 15mL) sol gel catalyst was spun onto the wafer at 3000 rpm for 30 seconds and dried. A generic photoresist was then spun on at 3000 rpm for 30 seconds. Patterning was obtained using various chromium and transparency photo-masks with an exposure time of 12 seconds and an intensity of 10 mW/cm<sup>2</sup>. After development of the photoresist mask and etching the catalyst film in BOE for 40 seconds, the sol gel patterned die were placed in a horizontal tube furnace for CNT growth. Growth was achieved at

700°C for 30 minutes with an admixture of H<sub>2</sub> and C<sub>2</sub>H<sub>2</sub> (385 sccm and 25 sccm respectively) as in Dong *et al* [2].

Characterization was performed using a field emission scanning electron microscope (FEI Sirion FESEM) and a high-resolution transmission electron microscope (Tecnai F-20 HRTEM). Figures 1(a) and 1(b) depict two post-growth patterns evaluated for integration into a thermal switch. The insets of both figures depict angled, higher magnification images of the pattern detail. Figure 2(a) demonstrates the ability to create complex arrays of CNT bundles with varying diameters for field emission experimentation. A more uniform array [Fig. 2(b)] was created for mechanical and thermal testing. Note that CNT growth is restricted to patterned catalyst locations in each case. Fig. 3(a) is a low magnification SEM image of an individual CNT bundle. The inset is of one section of the bundle's sidewall showing the vertically aligned CNTs at high magnification. This alignment is achieved through the density of growth provided by the catalyst. Fig. 3(b) is an HRTEM image revealing that the CNT consists of 5-6 graphitic layers. The surface of the tube is partially covered by amorphous carbon. This internal morphology is consistent across all growth patterns. The low number of layers present in these MWCNTs also suggests the potential of this method for producing double-walled or single-walled nanotubes. The method for controlled growth of MWCNTs presented here is thus highly adaptable and consistent in its internal morphology. Work is currently underway to optimize these structures for their mechanical, thermal and field emission characteristics.

**THE ELECTROCHEMICAL GROWTH OF ZnO NANOWIRES AND THEIR APPLICATION**, Athavan Nadarajah, [nadaraja@pdx.edu](mailto:nadaraja@pdx.edu) and Rolf Koenenkamp, Physics Department, Portland State University

ZnO films are widely used in important fields of photoelectric applications such as light emitting diodes, solar cells and color sensors. Their preparation by electrodeposition is interesting due to the flexibility of the method for large scale industrial applications at low cost. ZnO nanowires were grown in electrodeposition from aqueous solutions on fluorine doped SnO<sub>2</sub> coated glass substrates. The deposition involved a standard three-electrode arrangement with a Pt counter and Ag/AgCl reference electrodes from an aqueous solution. The created materials were studied using high resolution scanning electron microscopy. To fabricate light emitting diodes, the ZnO nanowires sample was coated with insulating polystyrene (PS) film in order to insulate the uncovered SnO<sub>2</sub> areas. The polystyrene coating typically involves a multiplayer process using high and low molecular weight solutions of polystyrene in toluene. The coating is carried out in such a way that the space between nanowires is homogeneously filled with the insulator. To establish a p-type contact to the nanowire tips, we applied a coating of PEDOT (poly (3,4-ethylene-dioxythiophene)) on the top of the PS layer. Finally gold contacts were deposited on the top of the sample by vacuum

evaporation to provide a Schottky barrier type contact for hole injection. The current voltage (IV) curves were taken using a semiconductor parameter analyzer in diode channel mode and electroluminescence (EL) spectra curves were taken with an ocean optics spectrometer.

**NEAR-FIELD OPTICAL MICROSCOPY NOVEL PROBE DESIGN**, Derek B. Nowak\*, Justin Hiester and Erik J. Sánchez, Physics Department, Portland State University

Scanning Near-field Optical Microscopy (SNOM) has generated great interest from amongst biologists and material scientists. SNOM is a relative new technique, which allows for imaging biological and material systems at spatial resolutions significantly lower than the diffraction limit. This technique has demonstrated optical imaging resolutions less than 50 nanometers, at room temperature and atmospheric pressure. To achieve higher resolutions, another similar technique was developed. The technique has been named Tip Enhanced Near-field Optical Microscopy, or TENOM. The key behind the sub-diffraction limit optical resolution is the creation of a localized electric field enhancement generated by the probe. It was shown by Krug and Sánchez in 2002, that the field enhancement factor is critically related to the geometry of the probe. The optimum geometry has seen little investigation. Up to now charged particle beams and chemical etching techniques, have been employed to create different probe geometries. These two methods can provide good reproducibility if done correctly, but they have limitations in terms of chemical hazards (HCL) and cost (dual-beam FIB).

Chemical etching has the issue of too-high of aspect ratios being created. This work investigates using the Gilbert-Taylor (G-T) cone geometry for the creation of a high field enhancement using a probe with a small apex and a large back taper angle. The creation of a nanometer sized G-T cone will be based on the physics of liquid metal ion emission of Au. Looking at the theoretical geometries of the G-T cones with Finite Difference Time Domain (FDTD) modeling techniques the potential field enhancement factors of the G-T geometry are determined.

**NOVEL FOCUSED ION BEAM EMITTER DEVELOPMENT**, Josh Smith\* and Erik J. Sánchez, Physics Department, Portland State University

We have developed a system for testing critical properties of Liquid Metal Ion Sources (LMIS) for use in focused ion beam (FIB) systems. This system allows the user to record and analyze a series of measurements such as extraction voltage, current, and emitter current. With this information we will be able to produce lifetime measurements, I/V curves, hysteresis curves and stability characteristics for a variety of materials. Currently we are working on the development of an alternative emitter sources other than Gallium as well as alternative emitter geometries to extend emitter lifetimes.

INTERNET BASED OPEN ACCESS CRYSTALLOGRAPHIC DATABASES, G. Upreti <sup>1</sup>, B. Seipel <sup>1\*</sup>, Morgan Harvey <sup>2</sup>, Will Garrick <sup>2</sup>, P. Moeck <sup>1\*</sup>,

<sup>1</sup> Department of Physics, Portland State University, P.O. Box 751, Portland, OR 97207, [girish@pdx.edu](mailto:girish@pdx.edu)

\* Oregon Nanoscience and Microtechnologies Institute (ONAMI), <http://www.onami.us>

<sup>2</sup> Academic & Research Computing, Portland State University

\* Advisory Board of the Crystallography Open Database, <http://crystallography.net>

Two freely accessible crystallographic databases are discussed: the Crystallographic Open Database (COD, <http://crystallography.net>) which contains approximately 34,000 structures in the Crystallographic Information File (CIF) format, and the Nano-Crystallography Database (NCD, <http://nanocrystallography.research.pdx.edu>) which we recently started to support image-based nanocrystallography and materials science education. CIF is the standard file format adopted by the International Union of Crystallography (<http://iucr.org>) for the archiving and distribution of crystallographic information. A subset of the COD, the Predicted Crystallographic Online Database, allows for 3D structural displays of approximately 2,600 entries. At the NCD site, thousands of entries in the COD and technologically important inorganic crystals can be visualized in three dimensions (3D) along with (2D) lattice fringe fingerprints plots. The latter supports the identification of unknown nanocrystal phases by means of lattice fringe fingerprinting in 2D. Morphological crystal information from the database “Bestimmungstabellen für Kristalle/Определитель Кристаллов,” (A.K. Boldyrew and W.W. Doliwo-Dobrowolsky, Zentrales Wissenschaftlichen Institute der Geologie und Schürfung, Leningrad/ Moscow, 1937/1939) will also be included in the NCD to support image-based nanocrystallography in 3D.

LIGHT MODIFICATION OF NANOPARTICLES FOR FIELD ENHANCEMENT, Mohan K. Vattipalli and Erik J. Sánchez, Physics Department, Portland State University

Analysis using Raman Spectroscopy is a very useful technique and has various methods to analyze the structural dynamics of biological and chemical samples. Synthesis of the nanoparticles using wet-chemical and lithography methods is a part of our research. Joining the two concepts allows for fast identification of unknowns and monitoring of physical changes occurring to the sample. The transformation of the shape of the nanoparticle using incident light from simple spherical to a prismatic shape was determined several years ago. These structures form a conducive environment on a substrate where highly localized fields are created. Modifying current techniques of directly using high intensities of incident fields to generate a detectable signal in either a Raman or fluorescence

methods, we try to use these prismatic structures with low incident intensities which may lead to controllable live detection on the single molecule level. Theoretical modeling and experimental development of fields involved with particle plasmons in complex yet reproducible geometries guide us in advancing the research. Work done so-far will be presented and future steps will be discussed.

**NANOMATERIALS FOR HYBRID ORGANIC/TiO<sub>2</sub> SOLAR CELLS,**  
Michael G. Walter, [mwalter@pdx.edu](mailto:mwalter@pdx.edu), Carl C. Wamser, [wamserc@pdx.edu](mailto:wamserc@pdx.edu),  
Department of Chemistry, Portland State University

A new type of solar cell has been designed around the recent discovery in our lab of a nano-fibrous thin film of polymerized tetra(4-aminophenyl) porphyrin (poly-TAPP). Poly-TAPP is a conductive polymer which can be deposited onto a transparent conductive glass electrode using cyclic voltammetry. The nano-scale morphology of these novel thin films shows very high surface area based on atomic force and scanning electron microscopies. The syntheses of the films differ from traditional porphyrin electropolymerizations in that pyridine is introduced as a co-solvent and can act as a base catalyst for the polymerization.

Our “inverse Grätzel cell” is unique in that it uses the porphyrin polymer network to dictate the nanoscale morphology of the electron acceptor/donor interface. Functionalization of the poly-TAPP surface with tetracarboxyphenyl porphyrin (TCPP) allows for additional light absorption and a built-in energy gradient for electron transfer through the device. Introduction of a thin TiO<sub>2</sub> film or other appropriate electron acceptor to fill the nano-pores of the porphyrin film requires careful chemical or physical deposition to maximize the contact area between these two materials and maintain a continuous conductive phase. Several TiO<sub>2</sub> deposition methods have been initially analyzed in conjunction with the construction of these cells. After filling the nanopores of the poly-TAPP with TiO<sub>2</sub>, a metal back contact of Al or Au is evaporated onto the TiO<sub>2</sub> surface to complete the cell. Porphyrin solar cells designed in this way have shown photovoltages greater than 1.0 V and photocurrents of up to 1.5  $\mu\text{A}/\text{cm}^2$  using AM 1.5 solar irradiation conditions.

## **Undergraduate Student Posters**

**CONTROLLING CURRENT AND VOLTAGE PROFILES FOR LIQUID METAL ION SOURCES,** Justin Hiester\*, Derek B. Nowak, and Erik J. Sánchez, Physics Department, Portland State University

Liquid Metal Ion Sources (LMIS) are widely used in Focused Ion Beam (FIB) systems with a main application in mask repair and head trimming for the semiconductor industry. The work of Swanson, Wagner, and Forbes pioneered the LMIS field. The focus of their work was in the development of functional LMIS sources, through the investigation of many different emitter designs and ion source

material. A majority of this research came to a stop after the development of a needle-reservoir LMIS, with gallium as the ion source. Since that time, a majority of research has focused on the development of improved charge optics to increase the resolution of the FIB. With the limited amount of information on the IV curves with respect to apex geometries, a study into this feature of the LMIS will be explored as a source of improved resolution. Building on the findings of these groups, the investigation of LMIS current and voltage profiles are determined by changing the profile of the end apex of the LMIS. Employing methods of chemical etching and mechanical grinding to shape the apex of the LMIS, the characteristic IV curve of the LMIS is determined. In order to accomplish this, a testing chamber has been created and automated with data acquisition interfacing via a Pentium class computer and National Instruments hardware.

FABRICATION OF CARBON NANOTUBES SYNTHESIZED BY THERMAL CHEMICAL VAPOR DEPOSITION AND PLASMA-ENHANCED CHEMICAL VAPOR DEPOSITION, Jennifer Jones, [jjones@pdx.edu](mailto:jjones@pdx.edu), Jianfeng Wu, Dr. Jun Jiao, [jiao@pdx.edu](mailto:jiao@pdx.edu), Physics Department, Portland State University

By fabricating carbon nanotubes (CNTs) within micro-gated field emitters, it is possible to reduce the required voltage and enable greater control over emission current. Potential applications of gated CNT field emitter arrays include flat panel displays, high frequency amplifiers, spacecraft propulsion systems, high voltage and high temperature electronics, portable x-ray sources, and multiple electron-beam lithography. The objective of this research is to facilitate carbon nanotube growth via Chemical Vapor Deposition (CVD) and plasma-enhanced Chemical Vapor Deposition (PECVD). The resulting CNT morphologies will then be characterized with electron microscopy techniques.

Carbon nanotubes have been synthesized on silicon substrates with Nickel catalysts, prepared by sputtering. After the deposition of the catalyst thin film, CNT growth was obtained either by a thermal CVD or PECVD method. Parameters being tested include the catalyst thickness, growth temperature, and growth time, all of which affect the growth and morphology of the carbon nanotubes. CNTs produced by a thermal CVD method are randomly oriented and unaligned, with an irregular cauliflower-like spherical formation at the tips. Growth by the PECVD method produces vertically aligned CNTs, due to the electric field in the plasma, with no irregularity at the tips. As a result, plasma-enhanced CVD provides a desirable and effective method for the synthesis of vertically aligned carbon nanotubes. Additional study is underway to develop carbon nanotube arrays through nanosphere lithography and PECVD growth.

GALLIUM NITRIDE CALCINED WITH COPPER OXIDE IN AIR AND NITROGEN: STRUCTURAL AND SPECTROGRAPHIC STUDIES, L. Noice<sup>1\*</sup>, noice@pdx.edu, B. Seipel<sup>1</sup>, P. Moeck<sup>1\*\*</sup>, C. Li<sup>1</sup>, R. Erni<sup>2</sup>, A. Gupta<sup>1,3</sup>, N. Browning<sup>2,3</sup>, K.V. Rao<sup>4</sup>, <sup>1</sup>Department of Physics, Portland State University, <sup>2</sup>Department of Chemical Engineering and Materials Science, University of California at Davis, <sup>3</sup>National Center for Electron Microscopy, Lawrence Berkeley National Laboratory, <sup>4</sup>Department of Materials Science, Tmfy-MSE, The Royal Institute of Technology, Brinellvägen 23, Rm 224, SE 100 44 Stockholm, Sweden

Fabrication of GaN based semiconductor devices often uses transition metals such as titanium and nickel for making ohmic contacts. These metals can diffuse into the semiconductor and influence the optoelectronic properties of the device. The potential of copper-doped GaN in tuning the optical properties of the semiconductor is unexplored. Therefore, ten samples of GaN calcined with CuO in either air or N<sub>2</sub> were analyzed by means of quantitative powder X-ray diffraction, scanning probe and parallel illumination transmission electron microscopy, energy dispersive X-ray spectroscopy, and electron energy loss spectroscopy in order to address the structural characterization of copper-doped GaN. Gallium oxide and multiple copper oxide phases corresponding to the calcination environment were detected. Significant changes in the N<sub>2</sub> processed GaN lattice parameters and electron structure indicate incorporation of both copper and oxygen into the GaN lattice as well as changes in chemical bonding due to the calcinations process.

SURFACE-ENHANCED RAMAN SCATTERING OF P-NITROBENZOIC ACID ON SILVER AND GOLD NANOPARTICLES, Cathy Pham\* cpham@linfield.edu, Dr. Brian Gilbert, bgilber@linfield.edu, Dept. Chemistry, Linfield College

There have been many previous research<sup>1</sup> of surface-mediated photochemistry of p-nitrobenzoic acid (PNBA) on roughened silver surfaces. We have begun work to investigate this phenomenon on gold and silver-gold alloy surfaces. Linking agents that have functional groups conducive to binding noble metals such as aminopropyl trimethoxysilane (APTMS) and mercaptopropyl trimethoxysilane (MPTMS) were used to bind colloidal metal nanoparticles to glass substrates. We report initial experiments of surface-enhanced Raman scattering (SERS) of PNBA and p-aminobenzoic acid on Ag, Au and Ag<sub>x</sub>Au(1-x) surfaces.

<sup>1</sup>See for example, P.G. Roth, R.S. Venkatachalam, and F.J. Boerio; *J. Chem. Phys.*, 1150-55. 15 July 1986.

STRAINED SI COATED GE NANOWIRES, Cheng Qi\* [chengq@pdx.edu](mailto:chengq@pdx.edu), Raj Solanki [solanki@pdx.edu](mailto:solanki@pdx.edu), Dept of Physics; Dept. of Electrical and Computer Engineering, Portland State University

Ge nanowires coated with non-lattice matched Si epitaxial layer are grown as potential building blocks of fast nanoscale electronic

devices. The significance of strained layer Si is that it allows higher carrier mobility compared to its bulk. These structures are grown in a two step process. First the Ge nanowires are grown, followed by epitaxial growth of Si shells. The structural characteristics of these nanowires characterized by SEM, TEM and EDS will be presented.

**CORRELATIONS BETWEEN LENGTH OF CARBON NANOTUBES AND THEIR ELECTRONIC PROPERTIES**, Steven Youkey\*, [youkey@pdx.edu](mailto:youkey@pdx.edu), Lifeng Dong, Jun Jiao, [jiaoj@pdx.edu](mailto:jiaoj@pdx.edu), Department of Physics, Portland State University

In the field of nanotechnology, single-walled and multi-walled carbon nanotubes (SWCNTs and MWCNTs) are widely regarded as two of the best candidates for building electrical circuitry at the ultra microscopic level. However, there is still much that is unknown about the nanotubes' specific electrical characteristics, such as conductivity. It has not yet been conclusively shown what effect the nanotube's length has upon these electrical characteristics. In this study, we use floating-potential dielectrophoresis techniques to align individual SWCNTs on multi-finger platinum electrode patterns, so that their specific resistivities/conductivity can be measured against, and compared to, their length. This is accomplished by suspending the nanotubes in a sodium dodecyl sulfate (SDS) solution, using dielectrophoresis to align the nanotubes on the electrodes, visually characterizing the patterns in a scanning electron microscope, and then measuring the resistances on a microchamber probe station. Once the electrical characteristics of carbon nanotubes are sufficiently well understood, we will become one step closer to being able to put SWCNTs and MWCNTs into the production of nanoelectronics.

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