

Macromolecular Interfaces with Life Sciences

Snapshots of Student Research



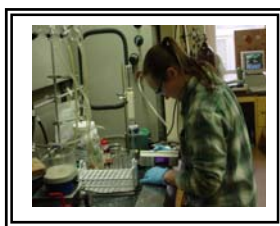
MILES graduates will be highly desirable recruits for progressive industries involving macromolecular and biological sciences. The research interests of the MILES students are described below.

Research Area 1: *Fundamental Investigations of Oxygen-Centered Free Radical Mechanisms*



WILLIAM JOE ALLEN received his B.S. degree in Chemistry from Jamestown College. He is working under the advisement of Dr. David Bevan in the Department of Biochemistry. Joe's research delves into the nanoscopic world of membrane proteins, specifically monoamine oxidase B - an important drug target enzyme with implications in Parkinson's disease. Joe uses various computational techniques to examine the behavior of monoamine oxidase B in complex with select inhibitors in their natural environment. His goal is to elucidate some of the uncertainties associated with this enzyme, its structural properties, and its activity so that researchers have the most complete picture with which to approach drug design.

DAVID BRYSON received his B.S. and M.S. degree in Biochemistry from The University of North Carolina at Greensboro. He will be working under the advisement of Dr. Webster Santos in Chemistry. His research involves a novel approach for finding a treatment for Parkinson's disease by targeting the messenger RNA of α -synuclein through the synthesis of biased chemical libraries, utilizing peptide dendrimers on solid support beads. He will also work to develop high-throughput screening assays to identify the molecular entities that interact specifically with α -synuclein mRNA.



MICHELLE GRIMM received her B.A. degree in Chemistry from Virginia Tech, and her M.S. degree in Chemistry from the University of Rochester. She is working under the direction of Dr. James Tanko in the Chemistry Department. Since joining Dr. Tanko's research group she has been examining the kinetics of ring opening reactions derived from cyclopropyl amines in order to probe the mechanism for enzymatic oxidation reactions of Cytochrome P450 and monoamine oxidase (MAO).

AMBER HANCOCK received a B.S. degree in Chemistry and in Physics from Radford University in 2005. Under the advisement of Dr. Jim Tanko, Amber is investigating the mechanism of hydrogen atom transfers of arylamine radical cations. Analogs of these radical cations are probes which may potentially aid in elucidation of the mechanism of oxidation by Cytochrome P450 and MAO for this class of substrates.



REBECCA HUYCK received her B.S. degree in Chemistry from Transylvania University. Dr. Tim Long, in the Department of Chemistry, is her advisor. Rebecca is examining the role of nitroxide radicals in understanding hydrogen abstraction processes in biological molecules, which is an important direction based on fundamental nitroxide reactivity studies.

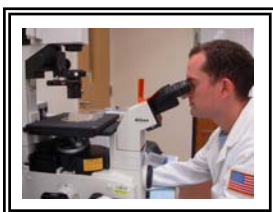
JUSTIN LEMKUL received his B.S. degree in Biochemistry from Virginia Tech. He participated in three years of undergraduate research with Dr. David Bevan, who continues to act as his dissertation advisor. Justin is using molecular simulations to understand the mechanism of aggregation of the amyloid β -peptide ($A\beta$), which has been implicated as having a central role in the development of Alzheimer's disease. Justin's simulations will examine various aspects of oxidative stress related to $A\beta$, with the ultimate goal of understanding the aggregation process and learning how dietary antioxidants may interfere with this aggregation.



SUSAN MITROKA received her undergraduate degree from Rutgers University in 2003. She is currently working under the advisement of Dr. Jim Tanko in Chemistry. Susan's work involves the usage of photochemistry to generate the hydroxyl radical and observe its reactivity with organic substrates. By monitoring these oxidation reactions in a controlled environment, an increasing understanding of the production and activity of these radicals can be established. This information can then be used as a model and extrapolated to the more complicated biological systems. Reactive oxygen species are increasingly being explored as the source for the onset of many diseases. Cancer, Amyotrophic Lateral Sclerosis, and Parkinson's disease are among the epidemics believed to be the result of oxidative stress to the body.

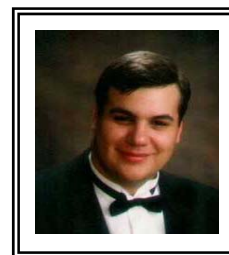
Research Area 2: Oxidation in Bio-Derived Monomers and Macromolecular Synthesis

JONATHAN GOFF received his B.S. degree in Chemistry from Virginia Tech. He is working under the advisement of Dr. Judy Riffle in the Chemistry Department. Jonathan is preparing well-defined homo- and co-polymers of polypeptides utilizing amine initiation of N-carboxyanhydride monomers weight distribution. The ultimate strategy is to functionalize oxidatively-stable cobalt nanoparticle surfaces with amine initiators and utilize those amine groups to grow polypeptides from the cobalt surfaces.



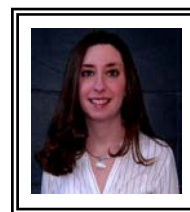
JOHN LAYMAN received his B.S. in Chemical Engineering from Virginia Commonwealth University. He is working under the co-advisement of Dr. Garth Wilkes in the Department Chemical Engineering and Dr. Tim Long in the Department of Chemistry. John is working to elucidate the fundamental structure-transfection relationships involved in polycation-mediated nonviral gene delivery. His efforts are currently focused on synthesizing novel gene transfection agents and evaluating their *in vitro* performance in different cell lines.

WILLIAM MILES received his B.S. degree in Chemical Engineering from the University of Florida. He is working under the advisement of Dr. Rick Davis in the Chemical Engineering Department. William is working in collaboration with groups at VCOM (Dr. Beverly Rzigalinski) and ECE (Dr. Kathleen Meehan) to tailor the surface of cerium oxide nanoparticles to control biological effects of the nanoparticles that have been found in cell culture studies. The ultimate strategy is go gain an understanding of the surface chemistry and surface interactions of the nanoparticles, which should allow for better understanding of the free-radical scavenging mechanism by which they operate, and also how they transport into the cellular environment. William is also working in collaboration with Chemistry (Dr. Judy Riffle) on the colloidal stability of magnetite nanoparticles using steric stabilizing polymers. The ultimate goal of this work is to successfully model these polymer/particle complexes such that the colloidal stability of the complexes can be predicted. This would allow for ideal polymer loadings to be calculated for any polymer molecular weight to optimize both the magnetic properties of the particles and the steric repulsion of the polymer layer.



MANA TAMAMI received her B.S. degree in Chemistry from the Shiraz University, Iran. She is working under the advisement of Dr. Tim Long in the Department of Chemistry. Mana is synthesizing novel ionenes having different spacers via Menshutkin reaction and investigating the effect of spacer length on biocompatibility and biodegradation, as well as thermal and mechanical properties. These novel synthetic strategies offer enhanced biocompatibility and biodegradation, as well as unique thermo-mechanical performance due to the formation of multi-layer ion channeling.

SHARLENE WILLIAMS received her B.S. degree in Chemistry from Wright State University. She is advised by Dr. Tim Long and Dr. Tom Ward in the Department of Chemistry. Sharlene is investigating the synthesis and characterization of novel ionene polymers for biomedical applications. In addition, she uses Michael chemistry to prepare macromolecules to study structure-property relationships and oxidative degradation.

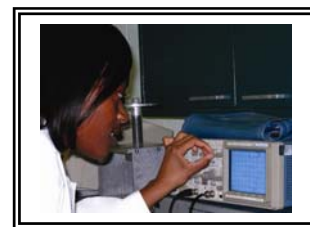


Research Area 3: *Oxidation Control Mechanisms in Complex Food and Beverage Matrices*



ANNIE AIGSTER received her B.S. in Dietetics and Food Science from the University of Florida and M.S. in Food Science from University of Florida. Dr. William Barbeau in Human Nutrition, Foods, and Exercise and Dr. Susan Duncan in Food Science & Technology are her co-advisors. Annie is developing novel cereal-based food products supplemented with resistant starch (RS) and is evaluating their physicochemical and sensory properties as influenced by storage time.

TAMESHIA BALLARD received her B.S. and M.S. degree in Biological Engineering from North Carolina State University and Virginia Tech, respectively. Dr. Kumar Mallikarjunan in Biological Systems Engineering and Dr. Sean O'Keefe in Food Science & Technology are her co-advisors. Tameshia is developing an economical method for extracting polyphenolic compounds from peanut byproducts and investigating the development of a method to efficiently extract polyphenolic compounds to be scaled up to an industrial type setting.



VINODINI EMMA BUCK received her Bachelors in Biology and Masters in Food Science from The Ohio State University. She is currently working on her Ph.D in Food Science under the guidance of Dr. Sean O'Keefe. Her project will focus on reducing lipid oxidation in chocolates containing peanuts.

SABRINA HANNAH received her B.S. degree in Chemistry, and her M.A. in Education, both from Virginia Tech. She is pursuing her Ph.D. in the Department of Food Science and Technology under the advisement of Dr. Susan Duncan. Sabrina is investigating the use of non-traditional polysaccharides for microencapsulation of omega-3 fatty acid sources. Microencapsulation aids in preserving the lipids and expands their potential as functional food ingredients.



KEVIN HOLLAND received his B.S. degree in Biology from the University of Pittsburgh at Bradford. He is working on his Ph.D. in the Department of Food Science and Technology under the advisement of Dr. Sean O'Keefe. Kevin is investigating the antioxidant capacity of peanut by-products to find applications for these extracts. These extracts may have applications in food products to prolong shelf life and preserve positive organoleptic qualities.

SHELLY HOGAN received her B.S. degree in Exercise Science and M.S. in Nutritional Biochemistry from Montana State University. Shelly is pursuing her Ph.D. under the advisement of Dr. Kevin Zhou in the department of Food Science and Technology. Shelly's research is focused on the identification and characterization of novel nutraceutical agents derived from functional foods. Identified bioactive compounds with antioxidant properties and specific enzyme inhibitory activity will be used to investigate their utility in combating diseases such as brain cancer and diabetes.





HEATHER JOHNSON received her bachelor's degree in Chemistry from James Madison University (Harrisonburg, Virginia) and will receive her Master's in Environmental Engineering from Virginia Tech in the Spring of 2008. She is working under Dr. Andrea Dietrich in the Civil & Environmental Engineering to analyze the practical use of ozone as a disinfectant in the installation of polymer piping in the distribution system of potable water. Water quality and the impact on the polymer pipes are the specific areas of interest.

JOHN KOONTZ in the Department of Food Science and Technology is studying the controlled release of natural antioxidants from polymer food packaging by molecular encapsulation with cyclodextrins. His advisor is Dr. Joe Marcy. The incorporation of cyclodextrins into polymer matrices can modify the mechanisms by which an additive is released. Molecular encapsulation using cyclodextrins was employed as a controlled release mechanism within linear low density polyethylene to gradually deliver an effective natural antioxidant concentration to a model food system. The controlled release of natural antioxidants from polymer packaging may more effectively limit oxidation, maintain nutritional quality, and extend the shelf life of foods.



PINAR OMUR-OZBEK received her B.S. degree from Middle East Technical University in Environmental Engineering (Ankara, Turkey) and her M.S. degree in Civil and Environmental Engineering at Virginia Tech. Her advisor is Dr. Andrea M. Dietrich in the Department of Civil and Environmental Engineering. Pinar is studying the mechanisms that produce metallic flavor in the mouth which incorporates lipid oxidation and carbonyl production in the presence of metals, saliva, and mouth tissue. She also investigates solutions to prevent it as metallic flavor is not only a problem for the drinking water consumers but to cancer patients undergoing chemotherapy that suffer from malnutrition as well.

PAUL SARNOSKI earned his bachelor's degree in Chemistry from Wilkes University (Wilkes-Barre, PA) and his M.S. degree in Food Science and Technology from Virginia Tech. He is working under the advisement of Dr. Sean O'Keefe in the Department of Food Science and Technology. Paul's research focuses on finding novel methods of utilizing peanuts and their by-products.



BRIAN STANEK received his B.S. degree in Food Science & Technology for Virginia Tech. He is working under the advisement of Dr. Susan E. Duncan in the Department of Food Science & Technology at Virginia Tech. Brian's Research examines the relationship of metallic taste/flavor sensation in the oral cavity and the efficacy of administering antioxidant blends to retard that sensation for those who are encumbered. Metallic sensation in the mouth can result in appetite suppression, malnutrition, and decreased quality of life for those affected. Potential implications of this research aim towards improving the lives of those afflicted by metallic taste by allowing them to resume their normal eating habits and way of life.

DR. JANET WEBSTER received her B.S. degree in Biology and her M.S. and Ph.D. degrees in Food Science & Technology from Virginia Tech. Dr. Webster evaluated the effect of light wavelength on the chemical composition, odor, and flavor of milk, the effect of novel packaging materials for their ability to inhibit light oxidation in milk, and developed a method to monitor photo-oxidation using Fourier transform infrared spectroscopy (FTIR) under the advisement of Dr. Susan Duncan in the Department of Food Science & Technology. Dr. Webster is the first MILES Ph.D. graduate and she received her Ph.D. degree in December 2006. Dr. Webster is currently working in the Proposal Development Team at Virginia Tech.



ANDREW WHELTON received his B.S. and M.S. degrees in Civil & Environmental Engineering at Virginia Tech and worked for the US Army three years before joining MILES IGERT. His advisor is Dr. Andrea Dietrich in the Department of Civil & Environmental Engineering. Andrew is examining chlorinated water induced degradation high-density and crosslinked polyethylene water pipe as well as contaminant interaction with new and degraded polyethylene. Results of this work will benefit those industries that design, use, and assess the safety of polyethylene products to include the medical, food and beverage, water, and public health industries.

Research Area 4: Oxidative Processes in Human and Animal Aging and Disease



COURIE COHEN received her B.S. in biology from Virginia Tech. She is pursuing her PhD under Dr Beverly Rzigalinski of the Department of Biomedical and Veterinary Sciences. Her research focuses on investigating the superior antioxidant properties of cerium oxide nanoparticles, and their use in the treatment of neurodegenerative diseases such as Parkinson's.

KWAKU B. GYENAI received his B.S. and M.S. degree in Laboratory Animal Science & Animal and Poultry Sciences from North Carolina Agricultural and Technical State University and Virginia Tech, respectively. His advisor is Dr. Ed Smith in the Department of Animal and Poultry Sciences. Kwaku's research has as its primary objective a determination of the effect of oxidative stress on the incidence and severity of toxin-induced dilated cardiomyopathy in the turkey (*Meleagris gallopavo*). It involves comparing oxidative stress levels in DCM-affected and unaffected birds and evaluating the effect on the severity of DCM of feeding synthetic antioxidants.



BEN LEPENE received his B.S. degree in Materials & Science Engineering from Virginia Tech. Ben is a Ph.D. Candidate under the direction of Dr. Craig Thatcher in the Department of Biomedical and Veterinary Sciences. Ben is developing an antioxidant delivery system that incorporates active receptor targeting and redox-sensitive release elements. He is currently studying the impact these delivery systems have on cellular oxidative damage and inflammation in an *in-vitro* murine macrophage cell line. Future efforts will assess the delivery system's ability to target alveolar macrophages in an equine animal model for human asthma.

REBECCA PHILLIPS received her B.A. in Biology from the University of Virginia and a M.S. in pharmaceuticals/drug metabolism from Virginia Commonwealth University. Rebecca is a Ph.D. Candidate under the direction of Dr. Ansar Ahmed in the Department of Biomedical and Veterinary Sciences. Rebecca is studying induction of nitric oxide in lipopolysaccharide stimulated splenic lymphocytes from estrogen-treated mice. The roles of specific transcription factors, cytokines, and chemokines are being examined. The overall goal is to reveal sites of estrogen-mediated alteration in lymphocyte cell signaling related to inflammation. This work may illuminate possible treatment targets for inflammation and autoimmune diseases as the links between oxidative free radicals and regulation of the immune system are explored.



DR. ABBY TURPYN PEAIRS received her B.S. degree in Biology from Mary Washington College. She has continued her investigations into the effects of macronutrients on oxidative stress and inflammation in overweight and obese individuals under the advisement of Dr. Janet Rankin in the Department of Human Nutrition Foods, and Exercise. Dr. Turpyn Peairs' research showed that macronutrient composition plays a role in diet-induced inflammation which may be related to oxidative stress. Dr. Turpyn Peairs recently graduated with her PhD from Virginia Tech (September 2007).

DR. AMY TANNER received her B.S. degree in Biology from Virginia Tech and her Doctorate in Veterinary Medicine from the VA-MD Regional College of Veterinary Medicine. Dr. Tanner is pursuing her Ph.D. under the advisement of Dr. Korinn Saker in the department of Biomedical and Veterinary Science. Dr. Tanner is evaluating the capacity of dietary antioxidants to inhibit breast cancer cell proliferation. She is conducting in vitro studies to determine cell viability, antioxidant capacity, cell protection against oxidative DNA damage, and cell signaling alterations following dietary antioxidant supplementation.

