(1) Modifying an RNA aptamer with drugs to specifically attack prostate cancer

Sheeniza Shah and Dr. David Smithrud

Department of Chemistry, University of Cincinnati, Cincinnati, Ohio

Despite recent advances in treatment, prostate cancer is still the second most commonly diagnosed cancer in men. To create a new prostate cancer specific therapy, a RNA aptamer, which is selective for prostate specific membrane antigen (PSMA) on prostate cancer cells, was modified with synthetic linkers to bind drugs. Two linkers have been synthesized and characterized by 1H-NMR: compound 5 and compound 9. Compound 5 possesses an ether linker, making it less labile in contrast to compound 9, which possesses an ester linker. Both compounds possess diethylstilbestrol (DES) and fluorescein. DES is an estrogen derivative that was used to treat prostate cancer. The linkers covalently attached DES to a fluorescein dye. The fluorescent tag enables visualization of the conjugate during in vitro assays. An alkyne moiety on the fluorescein will be used to couple to an azide on the RNA aptamer via click coupling. Once the conjugates are completed, their toxicities will be determined in prostate cancer cells.

(2) ROS-activated release of a PARP inhibitor to cancerous cells

Eva Mazzola, Olivia Reblando, Dr. Eddie Merino, Gurdat Premnauth

Department of Chemistry, University of Cincinnati, Cincinnati, Ohio

Cancer cells have higher levels of ROS compared to healthy cells. That observation has been used by the Merino lab to develop a ROS activated self-cyclizing agents that can be used as a ROS scavengers or a drug delivery system. In this project, we used the model as a drug delivery system to deliver a PARP inhibitor to the cancerous cells, NU1025. The role of NU1025 is to stop the DNA repair via the PARP process, which will lead to apoptosis. Our role this summer was to optimize the synthesis of the self-cyclizing/drug model using a metoxyphenol before using the expensive NU1025.

Self-cyclizing/methoxyphenol model
(3) Selective Hydrogen Peroxide Dependent Release of a Bioactive Compound From An Aptamer

Gurdat Premnauth, Eddie J.Merino

Department of Chemistry, University of Cincinnati, Cincinnati, Ohio

Actual chemotherapy drugs are assimilated with very aggressive side effects and it is important to develop novel drug systems more selective to cancerous cells. In the past years, the use of aptamers as drug delivery system have increased to provide that feature. Combining this with the higher level of ROS in cancerous cells it is possible to link an aptamer to a ROS-activated self-cyclizing agent to be able to selectively release a drug to the diseased cells. In this project the drug chosen is a PARP-inhibitor, NU1025, that once released to the cancerous cell will stop the DNA repair process and lead to apoptosis.

Figure 1: Selective release of a PARP inhibitor (NU1025) using an aptamer.

(4) Synthesis and PGE₂ Inhibitory Activity of Novel Diarylheptanoids

Taylor A. Gerrein, Richard D. McLane, Leon Le Cozannet-Laiden, Maxwell S. Boyle, Benjamin Cecil, Lindsey Lanzilotta, Zachary L. Taylor, Sarah R. Anthony, Michael Tranter, Amber J. Onorato
Inflammation is a protective response to harmful stimuli in the body that can also trigger negative effects when overexpressed. The most popular treatment for inflammation is NSAID pain relievers, which pose cardiovascular risk to patients. Microsomal prostaglandin E2 synthase-1 (mPGES-1) inhibitors have shown potential as an alternative to NSAIDs. Diarylheptanoids (DAHs), a class of natural products, have shown potential as mPGES-1 inhibitors. In this research next generation DAHs, based off of a DAH isolated from *Pleuranthodium racemigerum*, are being synthesized and their anti-inflammatory activity subsequently probed by investigation of their PGE2 inhibitory ability.

(5) Use and preparation of specific and nonspecific tRNA molecules for EMSA and FA study

Maryiah Haley¹, Ian Healy² and Pearl Tsang¹

¹Department of Chemistry, University of Cincinnati, Cincinnati, Ohio

To investigate the RNA binding preferences of a protein via EMSA and FA, certain procedures must be followed to prepare, purify and fluorescently label the desired RNA. The general process to do this are presented and discussed. The results obtained starting from isolation of a plasmid (‘pLysB19’) which codes for the target tRNA molecule, the purification of this DNA plasmid, its restriction digestion to produce the desired template and subsequent purification are presented. Successful use of this purified template for in vitro RNA transcription to produce the RNA for subsequent labeling is demonstrated. The successful use of such RNA for EMSA are shown in this poster.

(6) Enzymatic Ligation of ER-β Domains for NMR Study

Maryanne Refaei¹, Mike Howell², Al Combs³*, Mark Rance³, and Pearl Tsang¹

¹ Department of Chemistry, University of Cincinnati, Cincinnati, Ohio

² Protein Express, Blue Ash, Ohio

³ College of Medicine, University of Cincinnati, Cincinnati, Ohio
In the human body there are two estrogen receptor proteins (ERα and ERβ). These multidomain proteins act as transcription factors that activate upon binding to estrogen. Both estrogen receptors have a variable N-terminal region, a DNA binding domain, and a C-terminal hormone binding domain. The structure of the ERβ DNA binding domain has yet to be elucidated. The focus of this work is the purification of single domains of the ERβ construct for subsequent enzymatic ligation. To this end, several protein variants were cloned and purified in order to maximize protein solubility, ligation feasibility and yield.

(7) Investigating the Supramolecular Interactions Between C-methylresorcin[4]arene and Gatifloxacin and the Resulting Antibacterial Activity

Chandra Ade-Browne, Dr. Harish Chandra, Dr. Arnab Dawn, Prof. Jagjit Yadav, Prof. Harshita Kumari*

College of Pharmacy, University of Cincinnati, Cincinnati, Ohio

Naturally polyphenols are produced by plants, but their antioxidant, anti-inflammatory, anticancer, and antimicrobial properties represent the potential for human health benefits. Thus, in the development of new pharmaceutical ingredients, it is attractive to synthesize compounds that can mimic some of polyphenols' properties. Resorcinarenes, a class of polyphenols, has been extensively studied in the formation of host-guest complexes, however, the polyphenolic health benefits have been neglected. In this study, the supramolecular interactions between the resorcinarene and gatifloxacin, an in-market antibacterial drug, were characterized with spectroscopic techniques and the antibacterial activity of the combination was studied with in-vitro assays.

(8) Discovery and Characterization of Proteins Modulating Poly(ADP-ribose) Glycohydrolase (PARG)

Yasin Pourfarjam, Ah-Ra Cho and In-Kwon Kim
Poly(ADP-ribosyl)ation (PARylation), a reversible post translational modification, regulates DNA repair, DNA recombination, gene expression, mitotic entry, and cell-fate. PARylation is cytotoxic when accumulated and must be turned over rapidly. PAR glycohydrolase (PARG) is the predominant PAR turnover enzyme that counteracts the PAR synthesis by PAR polymerase 1 (PARP1). However, in contrast to PARP1, how PARG interacts with partners and how PARG activity is regulated are poorly understood. We have identified new PARG partners by human protein microarray. Notably, two ubiquitin ligases, KEAP1 and UBE2O, showed stable interaction with PARG, suggesting a potential regulatory mechanism for PARG.

(9) Impact of Reactive Oxygen Species (ROS) and Transition Metal ions (Fe$^{2+}$, Cu$^{2+}$) on tRNA Modifications

Niket Yadav, Manasses Jora, Patrick A. Limbach and Balasubrahmanyam Addepalli

Rieveschl Laboratories for mass spectrometry, University of Cincinnati, Cincinnati OH

Alteration of ribonucleoside modifications in response to xenobiotic stress is of great interest due to its association with disease.1 Hydrogen peroxide generates reactive oxygen species (ROS, eHOO•, HO•) in the presence of metal ions (e.g. Fe$^{2+}$, Cu$^{2+}$) via Fenton reaction under physiological conditions.2 To better understand the previously observed impact of ROS on modified nucleosides (Burns, unpublished), more in-depth investigations were undertaken. The information revealed from such studies, including the reproducibility of previous findings, effects of specific transition metal ions on modified nucleosides, limitations and potential solutions to the currently employed protocol, will be presented.

References:
**P-Hydroxybenzoic Acid Involved Pretreatments to Enhance the Enzymatic Hydrolysis of Aspen**

*Yequan Sheng,*a *Maobing Tu,*a,*b Changlei Xia*b

*a College of Chemical Engineering, Nanjing Forestry University, Nanjing 210037, People’s Republic of China

*b Department of Chemical and Environmental Engineering, University of Cincinnati, Cincinnati, OH 45221, USA

* Corresponding author. E-mail address: tumg@uc.edu; Fax: +1 513 556 2259; Tel: +1 513 556 4162

Enzymatic hydrolysis is an effective process widely employed to converted lignocellulosic biomass into value-added glucose. Usually, the biomass is pretreated first to weaken the binding between hydrolyzable cellulose, hemicellulose, and lignin. However, the lignin-lignin condensation can dramatically reduce the pretreatment effectiveness. As a lignin-degraded compound, *p*-hydroxybenzoic acid (PB) owns the capability to significantly hinder the self-polymerization of lignin. The effects of adding PB into the pretreatments on the enzymatic hydrolysis of pretreated aspen were investigated. The results revealed that PB was a qualified additive to improve the biomass pretreatments, and which was more effective in organosolv than dilute acid pretreatment.

**Functionalized Cellulose Nanocrystal (CNC) as Fuel Additive**

*Changlei Xia,*a *Maobing Tu,*a,* Zhongyang Cheng:b

*a Department of Chemical and Environmental Engineering, University of Cincinnati, Cincinnati, OH 45221, USA

*b Materials Research and Education Center, Auburn University, Auburn, AL 36849, USA

* Corresponding author. E-mail address: tumg@uc.edu; Fax: +1 513 556 2259; Tel: +1 513 556 4162

It is our vision that agriculture and forestry are not only the sources for foods, but also the sources for energy and engineering materials. This study is designed to dispersing the surface functionalized cellulose nanocrystal (CNC) in gasoline as a fuel additive. Of all energy consumption, about 36% is currently
harvested from petroleum, therefore, a CNC/gasoline hybrid fuel would very impressively consume cellulose. This would revolutionize the development of clean and green energy by providing a direct and efficient way to use the energy from biomass. In this study, the investigation of the modified CNCs dispersion in gasoline was performed.

(12) Effect of inhibitors on the yeast intracellular glucose in fermentation

Xin Tan, Maobing Tu,* Changlei Xia

Department of Chemical and Environmental Engineering, University of Cincinnati, Cincinnati, OH 45221, USA

* Corresponding author. E-mail address: tumg@uc.edu; Fax: +1 513 556 2259; Tel: +1 513 556 4162

Biomass hydrolysates can be fermented to produce bio-ethanol by yeast, however, the carbonyl degradation compounds will dramatically inhibit this conversion. Therefore, the investigation of inhibition mechanism may offer a targeted approach for the detoxification. Different from the reported mechanisms, we found that the inhibitors prevented the transport of glucose into yeast cells. To illustrate the glucose transport, yeast intracellular glucose was determined, and no intracellular glucose was detected for the completely inhibited yeast. Furthermore, fermentation with cell-free yeast extracts in the hydrolysate was observed, indicating that inhibitors would not limit the fermentation-related active substances but inhibit the glucose transport.

(13) Effect of food waste ethanol fermentation stillage on bioelectricity production from microbial fuel cells and its microbial community structure

Hongzhi Ma^{a,b,*}, Maobing Tu^{b}

a Department of Environmental Engineering, University of Science and Technology Beijing, China, 100083

b Department of Biomedical, Chemical and Environmental Engineering, University of Cincinnati, 2901 Woodside Drive, Cincinnati, Ohio 45221, United States
Food waste ethanol fermentation stillage obtained from 5 times cycle fermentation was used as the substrate in a single-chamber microbial fuel cell (MFC) to recover electric energy. Corresponding substrates inside the system were evaluated by fluorescence spectra, and microbial communities were also investigated to elucidate its influence on the MFC performance. Results demonstrated that output voltage and current respectively reached 0.29V and 1.4mA with an external resistance of 200Ω. Microbial community analysis by high-throughput sequence indicated that Advenella and Moheibacter occupied the highest proportion among all genera at the anode instead of Geobacter. These results may be due to complicated bioproduct accumulated in the stillage, and the existence of potential tetracyclines might possibly influence microbial communities.

(14) Extraction of Protein Thermodynamic Parameters from High-Throughput Differential Scanning Fluorimetry Assays

Thaiesha Wright, Jamie Stewart, Richard C. Page*, and Dominik Konkolewicz*
Department of Chemistry and Biochemistry, Miami University, Oxford, OH 45056, United States

Numerous techniques have been utilized for estimating standard Gibbs free energy of unfolding; however, most of these techniques require significant preparation time, high protein, and nontrivial optimization. We address this issue by presenting a parallelized differential scanning fluorimetry (DSF) approach that enables the Gibbs free energy of unfolding, the entropy of unfolding, and the enthalpy of unfolding to be extracted. This method assumes a two-state, reversible protein unfolding mechanism and provides the capacity to quickly analyze the biophysical mechanisms of changes in protein stability and to more thoroughly characterize the effect of additives, inhibitors, or pH.

(15) Computer simulation of mechanical unfolding of tandem Green Fluorescent Protein in bulk or mediated by the 26S proteasome

Mohammad Sadegh Avestan, George Stan and Abdolreza Javidialesadi
Department of Chemistry, University of Cincinnati, Ohio 45221, USA
26S proteasome is a major eukaryotic ATP-dependent molecular motor maintaining cell viability by unfolding and degradation of ubiquitinated substrates. 19S regulatory particle (RP) of proteasome unfolds substrates by threading them through its central pore and delivers them to 20S-CP for degradation. The molecular details of protein unfolding and translocation mechanisms by 19S-RP are not fully understood. Here, we use a coarse-grained model of 19S-RP and perform Langevin dynamics simulation of mechanical threading of tandem Green Fluorescent Proteins (N-GFP-linker-GFP-C) through the central pore of 19S-RP. We compare mechanical unfolding initiation of N-GFP-linker-GFP-C in bulk and mediated by the 26S proteasome.

(16) Surfactant Microstructure and Dynamics: A Case Where MD and NMR Drive Understanding

Allison Talley, Abdolreza Javidialesaadi, George Stan, Charlie Eads
Department of Chemistry, University of Cincinnati, Cincinnati, OH

The physical properties of surfactant and amphiphile aggregate structures, for example biological membrane bilayers or consumer cleaning products, are strongly modulated by the presence of guest molecules such as cholesterol, drugs, or flavors/fragrances. The ability to study structure and dynamics in these systems, and to assess the impact of guest molecules, can aid understanding the origin of many properties ranging from the mechanical strength and curvature of membranes to the viscosity, stability, and consumer appeal of soaps and detergents. NMR relaxometry provides standard experimental approaches to studying dynamics and structure in systems where the overall global structure is well defined (as in folded proteins and nucleic acids). However, in conformationally and configurationally dynamic systems like surfactant and amphiphile aggregates, and in related structured fluids, interpretation of NMR relaxation techniques becomes more difficult because of the complex time-and structure-dependence of interatomic interactions. Here we present an approach where atomistic molecular dynamic simulations of amphiphile aggregates are used in conjunction with NMR relaxometry to understand the structure and dynamics of amphiphile aggregates and their guests.
Effect of hinge disulfide bonds on antibody Binding Region of Immunoglobulin-G

Yasan Fonseka¹, Abdolreza javidialesaadi¹, Andrew Herr², George Stan¹

¹ Department of Chemistry, University of Cincinnati, Ohio 45221, USA
² Department of Molecular Genetics, Biochemistry and Microbiology, University of Cincinnati College of Medicine, Cincinnati, OH 45267-0524, USA

Immunoglobulin-G (IgG) Antibody is the most common antibody in human circulation. This Y-shaped biomolecule contains two heavy and light chains. Heavy chains are connected by disulfides bonds at hinge region which affect the dynamics of the Fab (V shaped region) of IgG. The effect of disulfide bonds on the flexibility of Fab region is not fully understood yet. We perform Langevin dynamics simulations using and implicit solvent model to elucidate the effect of disulfide bonds in the hinge region of IgG1, IgG2 and IgG4. We find that the larger number of disulfide bond in the hinge stabilizes the Fab region by limiting the motion of the arms of each IgG which results in decreasing the distance between the antigen-binding regions.

Exploring the Molecular Mechanisms of Microtubule Severing

Rohith Anand Varikoti, Ruxandra I. Dima

Department of Chemistry, University of Cincinnati, OHIO-45220

Microtubules (MTs) are the filamentous intracellular biopolymers of a globular protein, called tubulin which is a dimer comprising of two polypeptides, alpha-tubulin and beta-tubulin (tubulin dimers). MTs along with microtubule-associated proteins, MAPs, regulate various vital cellular processes. Among these MAPs are the MT severing enzymes, which belong to the ATP-dependent homo-hexamerases of ATPases associated with various cellular activities (AAA+) family of enzymes. These enzymes are known to bind to MTs in various orientations and for functional reasons they should bind to the acidic residue rich carboxy-terminal tails (CTTs) of tubulins. The binding mechanism and transfer of CTTs through the center pore of these enzymes is unknown. A combination of docking studies with Molecular Dynamics simulations and Normal Mode Analysis are used to investigate the initial binding and translocation of CTTs to proteins. We found that binding of Beta isoforms is preferred over Alpha isoforms, which recapitulates the behavior of spastin binding to CTTs from the experimental literature.
**A Computational Study of Fluoxetine’s Absorption and Emission Spectra**

Donna Odhiambo and Patrick M. Hare, Ph.D.

Northern Kentucky University

Fluoxetine is one of the most popular SSRI antidepressants in use. With its increasing global usage, fluoxetine is also of growing concern in aquatic toxicology because of its appearance in natural waters. UV photolysis is a possible remediation route. To understand fluoxetine’s interactions with UV light, the excited state energies and geometries of several enantiomeric conformers of fluoxetine were calculated with TDDFT to determine if there are differences between the structures and their photophysical behavior. Calculated absorption spectra for the enantiomers agree well with experiment, but fluorescence spectra do not, possibly because of solvent effects.

**Differentiating Positional Isomers of Nucleoside Modifications by Higher-Energy Collisional Dissociation Mass Spectrometry**

Andrew Burns, Manasses Jora, Balasubrahmanyam Addepalli, Robert Ross, Peter Lobue and Patrick A. Limbach

Rieveschl Laboratories for mass spectrometry, University of Cincinnati, Cincinnati OH

Over 150 post-transcriptional modifications (PTMs) have been documented in different types of RNA. Collision-induced dissociation based mass spectrometry has been the standard method for PTM detection. Here, the modified nucleoside molecular ion (MH⁺) is fragmentated into charged nucleobase (BH₂⁺) and neutral ribose sugar to compute the mass difference of charged ions, so that the modification can be identified. Positional isomers of PTMs exhibit identical pattern of molecular and base ions, thus making their identification challenging. In this investigation, we show that higher-energy collisional dissociation mass spectrometry can be used to identify positional isomers of modifications in single analysis.

References:


(21) The effects of peroxide exposure on the transfer RNA of radiotrophic C. neoformans

Melissa Kelley, Ryan Myers, Manasses Jora, Lauren Schultz, Balasubrahmanyam Addepalli, Patrick A Limbach

Rieveschl Laboratories for mass spectrometry, University of Cincinnati, Cincinnati OH

Cryptococcus neoformans is a fungus capable of surviving in radiation-ridden conditions, such as Chernobyl. Ionizing radiation damages the cell indirectly through the production of reactive oxygen species (ROS). RNA may be affected by the presence of ROS, therefore, this organism may be able to adapt to this damage. Here, the impact of peroxide exposure on C. neoformans transfer RNA is investigated through liquid chromatography coupled with mass spectrometry (LC-MS). Understanding post-transcriptional RNA modifications may lead to insight on C. neoformans survivability.

(22) Multiplex analysis of modified oligoribonucleotide through polyA polymerase (PAP) with azido modified NTP labeling

Kayla Borland and Patrick A. Limbach

Rieveschl Laboratories for mass spectrometry, University of Cincinnati, Cincinnati OH

Mass spectrometry (MS) has become an enabling technology for the characterization of post-transcriptionally modified nucleosides within ribonucleic acids (RNAs). Previously duplex-based strategies have been reported to characterize modifications in 2 different samples. Here we describe an enzymatic approach for multiplexing modified RNAs. Using poly adenosine polymerase (PAP) one 2’ azido modified nucleotide can be added to the 3’-terminus of modified RNA. This addition can allow for the use of click chemistry to uniquely tag each sample. Because a variety of click reagents exist, upon reaction completion a mix of synthetic RNA samples can be uniquely tagged for MS/MS analysis.
Improving the sequence coverage of RNA modification mapping by LC-MS

Priti Thakur, Patrick Limbach and Balasubrahmanyam Addepalli

Rieveschl Laboratories for Mass spectrometry, University of Cincinnati, Cincinnati OH

Structure-function correlation of RNA requires information about the location of resident chemical modifications in its sequence. RNA modification mapping uses nucleobase specific ribonuclease (RNase) enzymes and liquid chromatography coupled with mass spectrometry (LC-MS), for mapping location of the chemical modification in RNA. Commercially available RNase T1 (G-specific) and RNase A (pyrimidine-specific) are widely used in mapping procedures. Employing additional base-specific enzymes such as U-specific RNase MC1 (1) and C-specific RNase cusativin (2) can complement and improve the sequence coverage of modified RNA through generation of overlapping digestion products. We will present our preliminary studies conducted on Escherichia coli total tRNA using multiple nucleobase-specific enzymes to improve the sequence coverage and its utility in obtaining the sequence of individual tRNA molecules present in a mixture.

References:


Probing the Effects of Ultraviolet Radiation on tRNA Modifications of Saccharomyces cerevisiae

Richard Mitchell, Christopher O’Connell, Congliang Sun, Manasses Jora, Patrick A. Limbach and Balasubrahmanyam Addepalli

Rieveschl Laboratories for mass spectrometry, University of Cincinnati, Cincinnati OH

Over 150 types of chemical modifications are contained in RNA, and they impact development, stress responses and disease.1 In this study, we will present the effects of UVA radiation on tRNA modifications of Saccharomyces cerevisiae through their characterization by liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS). We will present the effects of UVA on purified yeast tRNA (in vitro effects) and compare against the effects observed under intracellular conditions (in vivo effects), to
understand any differences in susceptibility. This information is expected to provide insights into the RNA damage that occur in human cells and tissues following UVR exposure.

References


(25) Optimization of dopamine-specific aptamers for electrochemical sensors

Mirelis Santos-Cancel and Ryan J. White

Department of Chemistry, University of Cincinnati, Cincinnati, Ohio

The role of biogenic amines such as dopamine, serotonin, and norepinephrine as neurotransmitters is to mediate communication pathways between neurons. Several analytical methodologies have been applied to the continuous monitoring of neurotransmitter release, including microdialysis, optical imaging, and electrochemistry. Although the overwhelming number of reports showing spatially resolved quantification of biogenic amines, specifically dopamine, these approaches fail to discriminate between structurally similar molecules. This work encompasses the development of an electrochemical, aptamer-based (E-AB) sensor using rationally designed deoxyribonucleic acid (DNA) oligonucleotides to create a probe able to detect dopamine with high specificity, and improved sensitivity and linear range.

(26) ICP-MS-MS Analysis of Biological Micro Samples with Heteroatoms as Internal Tag for Mass-Free Quantification of Selected Elements

Cory Stiner1,2, Hesamedin Hakimjavadi3, Kavitha Subramanian Vignesh4, George Deepe Jr.4,5, Judith Heiny3, Julio A Landero Figueroa1,2

1 Department of Chemistry, University of Cincinnati, Cincinnati, OH USA
2 University of Cincinnati/Agilent Technologies Metallomics Center of the Americas, Cincinnati, OH USA
3 Department of Molecular and Cellular Physiology, University of Cincinnati, Cincinnati, OH USA
ICP-MS is the preferred method for elemental analysis at trace and ultra-trace levels, but its use in biomedical research has been limited by sample volumes required to achieve the needed precision. Currently, cell numbers in the range of $10^6$ to $10^9$ cells (or micrograms to milligrams wet weight) are required for mass-based concentration analysis of trace elements in biological samples. Here we develop approaches for mass-free quantification of selected elements in biological micro samples. As proof-of-principle, we demonstrated quantification of elements in various cultured samples containing as little as $10^4$ cells and in samples of 1-10 freshly isolated skeletal myofibers.

(27) **Effects of overliming and activated carbon on detoxifying the carbonyl inhibitors in dilute acid hydrolysates of lignocellulosic biomass**

*Yu Zhang, Changlei Xia, Maobing Tu*

Department of Chemical and Environmental Engineering, University of Cincinnati, Cincinnati, OH 45221, USA

* Corresponding author. E-mail address: tumg@uc.edu; Fax: +1 513 556 2259; Tel: +1 513 556 4162

Lignocellulosic biomass as the most abundant sustainable resource can be converted into biofuels by microbial fermentation. The biomass hydrolysates comprise fermentable sugars, however, the carbonyl degradation compounds present severe toxicity to the microorganism. This study was aimed at identification and detoxification these inhibitors. Gas chromatography-mass spectrometry (GC-MS) was employed, and 46 carbonyl compounds were identified as potential inhibitors. The detoxifications were performed by a combined method, i.e. overliming and activated carbon (AC) absorption, to remove 92.6% of identified inhibitors and make the hydrolysate fermentable. However, overliming and AC solely only achieved 73.9% and 82.2% of removal, respectively, with unfermentable hydrolysates.
Biocompatible substrates for surface-enhanced Raman spectroscopy (SERS) of protein and lipid membranes

Ian Bruzas, William Lum, Zohre Gorunmez, Laura Sagle

University of Cincinnati, Department of Chemistry

Surface-enhanced Raman spectroscopy (SERS) provides direct vibrational information of molecules near noble metal nanoparticles (NMNs). The resonant, collective oscillation of conduction band electrons of NMNs amplify the Raman signal such that single molecule sensitivity has been demonstrated. SERS has great potential for biophysical investigations involving proteins and lipids including: protein dynamics, enzyme catalysis and lipid membrane dynamics. There is a need for biocompatible SERS substrates, as direct interaction of biological molecules with NMNs often lead to structural and functional changes. Here we present two substrates that incorporate a liposome or silica spacer layer for biocompatible measurements of protein or lipids.

Photodynamic Inactivation of Multidrug-Resistant Staphylococcus aureus (MRSA) Using Hybrid Photosensitizers

Niranga Wijesiri, Tevhide Ozkaya-Ahmadov, Peng Wang, Jinnan Zhang, Hong Tang, Xinjun Yu, Neil Ayres* and Peng Zhang*

University of Cincinnati, Department of Chemistry

Multidrug-resistant Staphylococcus aureus (MRSA) has become one of the major bacteria associated with various infections, leading to morbidity in both healthy and immune-compromised populations worldwide. Herein, we report a novel type of hybrid photosensitizer based on amphiphilic block copolymer functionalized gold nanoparticles. The hybrid photosensitizers display greatly enhanced singlet oxygen generation and outstanding photodynamic inactivation efficacy against MRSA under light illumination.
Light-Activated Chemical Probing of Nucleobase Solvent Accessibility Inside Living Cells

Jojo Joseph¹, William H. Coldren¹, Chao Feng², Dalen Chan², Robert C. Spitale²,³, and Christopher M. Hadad¹

¹Department of Chemistry and Biochemistry, The Ohio State University, 100 West 18th Avenue, Columbus, Ohio 43210
²Department of Pharmaceutical Sciences, University of California, Irvine. Irvine, California 92697
³Department of Chemistry, University of California, Irvine. Irvine, California 92697

Many RNA functions are controlled by the formation of specific structures and an understanding of each structural component is necessary to elucidate its function. Measuring solvent accessibility intracellularly with experimental ease is an unmet need in the field. We present a novel method for probing nucleobase solvent accessibility by the light activation of aroyl azides, specifically nicotinoyl azide (NAz), to form aroyl nitrenes. We have studied the photochemistry of NAz with the tools of ultrafast time-resolved (TR) spectroscopy and computational chemistry. Density functional theory (DFT) calculations were performed to characterize the reactive species formed by the photo-irradiation of NAz and to analyze the reaction mechanism. The femtosecond (fs) TR infrared (TRIR) and UV-Vis studies showed the evidence of nitrene formation, and the rates of formation and decay of intermediates have been calculated. Consistent with previous reports of excited aroyl azides, photolysis of NAz gives rise to the nitrene species with a thermally accessible singlet nitrene. Finally, we demonstrated that our new method forms adducts with the solvent-exposed region of purine residues.

Photocatalytic Visible Light Excitation of γ-Azido-Butyrophenones Using Metal-Based Photocatalysts

Nayera Abdelaziz, and Anna D. Gudmundsdottir*,†

†Department of Chemistry, University of Cincinnati, Cincinnati, Ohio 45221-0172, United States

Photochemistry is a useful way for synthesizing organic molecules. Most organic compounds do not absorb visible light, but photocatalysts which are metal-based complexes make it possible to use visible
light to carry out photoreactions. The ability to use visible light for carrying out photoreactions is accessible as either sun light or environmental friendly LEDs, can be used as light sources. Our group previously reported the first detection of triplet alkynitrenes in solution by laser flash photolysis of α-azidoacetophenone derivatives which have a built-in triplet sensitizer. Here we report the photosensitization of γ-Azido-Butyrophenones using [Ru(bpz)3][BF6]2, and [Ir{dF(CF3)ppy}2(dtbpym)}PF6 as catalysts. We compared photocatalysis products with products of the in-built triplet sensitizer. We also studied the photoreactivity obtained with the triplet sensitizer and photocatalyst by preforming transient spectroscopy, product studies and theoretical calculations.


Alexis Mack, Upasana Banerjee, Gudmundsdottir Group

Department of Chemistry, University of Cincinnati, Cincinnati, Ohio 45221-0172, United States

Solid-state chemistry is a vital approach for tackling two facets of global concern: minimizing the use and generation of hazardous substances while providing safe, affordable and effective medicine. Additionally, sunlight is a sustainable form of energy for its unwavering, natural quality. Traditional photo-reactors such as the mercury arc lamp convert only a portion of applied energy into light. A solid-state reaction was carried out by direct sunlight photolysis to determine the feasibility of bringing drugs to fruition by more sustainable means. This chemistry was studied through a solid-to-solid transition.

The starting material of the solid-to-solid reaction was diene azide. The significance of azide (N3) lies in the potential to construct heterocycles: moieties fundamental in pharmaceutical production. This project’s aim was to synthesize an organic heterocyclic moiety: pyrrole (C4H4NH). Common pharmaceuticals, such as oxytocin, consist of a moiety of similar composition. This study shows sunlight photo-induces diene azide to yield a clean conversion to pyrrole. This data suggests that sustainable, solid-state and energy efficient conversions have the capability to bring superior pharmacological properties to drug candidates.
Elucidating how crystal lattice controls photoreactivity of a tertiary alkylazide

Upasana Banerjee, † Sujan K. Sarkar, † Jeanette A. Krause, † Manabu Abe, ‡ and Anna D. Gudmundsdottir*† †Department of Chemistry, University of Cincinnati, Cincinnati, Ohio 45221-0172, United States ‡Department of Chemistry, Graduate School of Science, Hiroshima University, Hiroshima 739-8526, Japan

Solid-state photoreactions are crucial from the synthetic point of view, as they tend to be more stereo and regioselective compared to solution photoreactivity. However, for further applications, it is better to understand how the crystal lattice controls the solid state reactivity and to elucidate solid state reaction mechanism and correlate the solid state kinetics with the crystal lattice. We report photoreactivity of a tertiary alkylazide, where we get different photoreactivity in solution, solid-state and in cryogenic atmosphere. Room temperature reactivity in solution and solid-state comes from the alpha cleavage, although in solid-state we get selectivity. Cryogenic photoreactivity comes from tertiary triplet alkylnitrene, directly detected for the first time using ESR, Low temperature UV and IR spectroscopy.

Wavelength specific synthesis of Chromanones

Sobiya George, Anna Gudmundsdottir

Department of Chemistry, University of Cincinnati, Cincinnati, Ohio 45221-0172, United States

Photo reactivity of a molecule with multiple chromophores leads to the formation of different photo products at different wavelengths due to the wavelength specific reactivity of each chromophore. So, by irradiating the molecule at specific wavelengths the photo reactivity of a molecule can be controlled. Using LEDs is easier to achieve wavelength selectivity and more sustainable. Chromone hybrids shows interesting bio activities for the potential treatment of Alzheimer’s disease as well as radical scavenger activity. Synthesizing chromones and chromones based compounds using a more sustainable and efficient method would be ideal. In this work, the wavelength dependent synthesis of chromone and studies on the photo reactivity and the reaction mechanism is presented.
Gas Powered Crystals and Their Potential Applications

Dylan Shields¹, Stefan Schramm², Jeanette Krause¹, Durga Karothu², Anna D. Gudmundsdottir¹

¹University of Cincinnati, Cincinnati, Ohio, USA
²New York University Abu Dhabi, Abu Dhabi, UAE

Molecular machines are small instruments that can convert external stimuli, such as light, into mechanical movements. Traditionally, polymers have been used to achieve this type of function and have found uses in synthetic muscles, inchworm-like propulsion, and micro-tweezers. More recently molecular single crystals have been targeted as a replacement due to their advantages over their polymer predecessors such as easier structural modification and quicker response times. Finding new ways of creating and powering molecular machines can have profound impact on the usefulness of these promising materials. X-ray crystallography, video microscopy, laser flash photolysis, and quantum mechanical calculations were used to characterize a new class of gas releasing organic crystals and theorize potential applications.

Spectroscopic Scope for the Reaction Mechanism of 2-Azido1-bromoindenone at Ambient and Cryogenic Temperatures.


Department of Chemistry, University of Cincinnati, Ohio, USA.

Photolysis of 2-azido-1-bromo-indenone (1) in argon-saturated acetonitrile yields pyrazine (3) in good yield (50%), through dimerization of triplet vinylnitrene (2). Laser flash photolysis of 1 result in broad absorption due to triplet vinylnitrene at λ_{max} 340 nm and 410 nm in acetonitrile. The irradiation of azide 1 in 2-methyltetrahydrofuran (MTHF) matrices at 10 K resulted in the ESR spectrum of triplet vinylnitrene, which is stable up to at least 100 K. The zero-field splitting parameters for triplet nitrene, D/\hbar c = 0.33 cm\(^{-1}\) and E/\hbar c = 0.006 cm\(^{-1}\), verify that it has significant 1, 3-biradical character. Density functional theory (DFT) calculations support the characterization of triplet vinylnitrene and the proposed mechanism for its formation. Because triplet vinylnitrene is relatively stable, it has potential use as a building-block for high-spin assemblies.
The photoinduced phenomena of nitropolycyclic aromatic hydrocarbons (nitro-PAHs) has been studied on numerous systems from 9-nitroanthracene to 1-nitropyrene. Based on their work on photochemistry of 9-nitroanthracene, Chapman and his co-workers proposed two different photodecomposition pathways for nitro-PAHs based on the orientation of nitro group: 1) dissociation-recombination and 2) intramolecular rearrangement. Unlike previously studied nitro-PAHs, nitrocorannulene has a curved bowl-shaped polycyclic aromatic hydrocarbon, \( \text{C}_{20}\text{H}_{10} \), which consists of five six-membered rings fused together resulting in a five-membered ring in the core of the molecule. We studied the photochemistry of nitrocorannulene, and investigated its decomposition pathway using experimental and computational tools.

Contrasting the Mechanism of Indole Formation from Ortho-substituted aryl azide (1) with the reactivity of the corresponding arylnitrene 3

Onyinye Osisioma and Anna D Gudmundsdottir

University of Cincinnati, Chemistry Department
Recently, Visible light sensitization with transition metal photocatalysts have been used to selectively converts azide 1 to the corresponding indole 2.\textsuperscript{1} We studied the mechanism for the photoreactivity of 1 using product studies, laser flash photolysis, ESR spectroscopy and matrix isolations. At cryogenic temperature we detect the formation of arylnitrene 3 which decays by dimerization. Arylnitrene 3 was characterized with UV and ESR spectroscopy. In contrast, laser flash photolysis at ambient temperature reveals formation of triplet excited state of 1 that reacts to form indole 2, without forming arylnitrene 3. We used DFT calculation to support the reaction mechanism at cryogenic and ambient temperature.

\[ \text{hv, 450 nm} \]

\[ \text{Ru(byp)}_3\text{Cl}_2 \]

\[ \begin{array}{c}
\text{N}_3 \\
\text{1} \\
\text{hv, 450 nm} \\
\text{Ru(byp)}_3\text{Cl}_2 \\
\text{2}
\end{array} \]


(39) **Photodynamic inactivation of bacteria using a photosensitizer-polymer conjugate**

Rebecca Nogueira e Silva; Peng Zhang

Department of Chemistry, University of Cincinnati

Since photodynamic therapy has been used for a wide variety of purposes, it is important to develop strategies to overcome the known photosensitizer insolubility, improving its application in biological media. In this work, coupling between a hydrophilic polymer and a hydrophobic photosensitizer was successfully achieved by carbodiimide chemistry. The product was characterized by UV-Visible, NMR and Infrared spectroscopies, and its fluorescence properties was analyzed. Antibacterial properties of the polymer-photosensitizer conjugate were studied using two strategies, assembled in a silica nanoparticle and incorporated in a gel. Results indicated the product is more effective against tested bacteria in gel form than as a nanoparticle.
**Formation of new Transition metal complexes containing two α-hydroxy acid moieties**

Ahmed Elshewy, Michael J. Baldwin

Department of Chemistry, University of Cincinnati

To sequester iron, bacteria biosynthesize molecules called siderophores that bind Fe(III) very strongly. Some siderophores are photochemically active. These all have an α-hydroxy acid related functional group. A series of new two α-hydroxy acids-containing chelates inspired by photoactive marine siderophores, along with their transition metal complexes are being synthesized and characterized structurally and photochemically. These new chelate structures are being designed to accommodate two different metal sites including one photo active iron site and a second variable metal site.

**Evaluating the Reversibility of Vapochromism in a Platinum(II) Salt**


Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221-0172

Vapochromic platinum(II) salts undergo distinct color changes upon absorption and desorption of certain volatile organic compounds. Typically, this behavior has been described as reversible. In this presentation, we report investigations of the colorimetric response of a platinum(II) salt to acetonitrile vapor. The vapor absorbed and desorbed forms have been fully characterized by diffraction methods. However, evaluation of the reversibility of this system by emission spectroscopy, X-ray powder diffraction, and imaging methods reveals surprising underlying complexity, which calls into question assumptions about reversibility in vapochromic systems.

**Synthesis of hardwood lignin model polymers and its effect on cellulase enzymatic hydrolysis**

Conghui Yue, Hairong Guan, Maobing Tu

Department of Chemistry, University of Cincinnati
Lignin is the second most abundant source of renewable carbon on earth. Lignin could be used to produce aromatic chemicals in industry. The extracted lignin structures are altered compared to the native lignin. Lignin model polymers have been used to investigate biosynthesis and biodegradation of lignin. The lignin model polymer contain β-O-4 and β–β linkages which are structural motifs ubiquitous in native lignin. The addition of the lignin model polymers show slightly inhibitive effect on cellulose enzymatic hydrolysis, similar to the effect of native lignin on Avicel degradation to glucose.

(43) Effects of metal valence and size on the structure of siderophore-inspired complexes

Mary R. Warmin, Michael J. Baldwin
Department of Chemistry, The University of Cincinnati, Cincinnati, OH 45221
Siderophores bearing alpha-hydroxy-acid moieties are natural compounds which bind iron (III) tightly. Light triggers the decarboxylation of the siderophore and the reduction of the iron. The purpose of the work presented here is to determine the effects of metal size and valence on the structure of siderophore-inspired metal complexes. Initial results indicate that titanium and copper form monomeric complexes and polymeric linear chains, respectively. Aluminum complexes of Sal-AHA formed as a mix of dimeric and trimeric structures. Here we show that the reaction conditions influence the formation of dinuclear or trinuclear Al(III)[Sal-AHA] complexes.

(44) Synthesis and Reactivity of Copper Complexes Supported by a Bis(phosphino)amine Ligand

Arundhoti Chakraborty, Dewmi Ekanayake, Hairong Guan
Department of Chemistry, The University of Cincinnati, Cincinnati, OH 45221
Copper hydride complexes have gained attention due to the high selectivity and mildness in reducing organic molecules. In this study a new copper hydride complex with the bis(phosphino)amine ligand has been isolated and fully characterized. The synthesis of this complex involves hydrogenolysis of copper tert-Butoxide species. The $^1$H NMR spectrum and the crystal structure support a hexameric core with $(HN(CH_2CH_2P^iPr_2)_3Cu_6H_6$ formula. Reduction of carbon dioxide has been carried out with the copper
hydride complex and the resulting copper formate complex has been isolated and characterized. Catalytic hydrogenation of aldehyde and ketones has been accomplished.

(45) **Synthesis and Activity of a PNP-Ligated Iron Hydride Complex for Homogeneous Catalysis**

Joel D. Collett, Hairong Guan

Department of Chemistry, The University of Cincinnati, Cincinnati, OH 45221

The new synthesis of a pyrrole backbone PNP iron hydride (FeH(CO)₂PNPCy₂) has been developed. The complex is highly thermally stable, allowing it to potentially be effective as a catalyst under harsh reaction conditions like those associated with carbonyl hydrogenations. Investigation of catalytic effectiveness is ongoing.

(46) **Investigation of FeNi Heterobimetallic Complex**

Evan Lydon, Hairong Guan

Department of Chemistry, The University of Cincinnati, Cincinnati, OH 45221

FeNi heterobimetallic organometallic complexes are of great interest because of their potential to mimic FeNi hydrogenase enzyme which are known to activate dihydrogen. The goal of this research was to cause the two complexes to interact to form a FeNi-bimetallic complex by combining two characterized, highly active Ni and Fe hydride complexes. By tuning the steric bulk around the metal centers, it was shown that a bimetallic complex could form. This new complex was shown to interact with CO₂ and dihydrogen, and evidence for a short lived, rare iron formyl species was observed.

(47) **Investigation of the Catalysis of the Aerobic Decomposition of Juglone and Resorcinols**

Lacie Evans, Lauren Delong, Whitney Rymer, and Michael J. Goldcamp

Wilmington College, Wilmington, OH 45177
Several phenol, catechol, and quinone compounds are found in plants, such as urushiol from poison ivy, resorcinols from mangoes, and juglone from walnuts. These types of substrates react with oxygen, catalyzed by a number of metalloenzymes. The catalysis of the aerobic decomposition of juglone and resorcinols by various transition metal complexes is being investigated. Preliminary data show that Fe(III)(TPA) and a Ni(II)-bisoximate complex both promote transformation of juglone to a product consistent with hydroxylation followed by oxidative cleavage of the resultant catechol. Extracts of mango skins show the presence of the resorcinols; reactions of these extracts will be studied. 

(48) Coordination Polymers of Complexes of Divalent Metal with Ligands Containing α-Hydroxy Acetate and Pyridine Groups.

Spencer Lanhan¹, David Bellus¹, Alena Moore¹, Michael J. Goldcamp¹, Mark Chrisman¹, Jeanette Krause², and Michael J. Baldwin²

(1) Wilmington College, Wilmington, OH 45177
(2) University of Cincinnati, Cincinnati, OH 45221

Alpha-hydroxy acid (AHA) groups can bind release iron ions after photolysis, which can be useful in a number of applications. New ligands have been synthesized by reaction of 4-amino-2-hydroxybutyric acid with pyridine-2-carboxaldehyde or 2-benzoylpyridine to form their respective imine products. X-ray structures of Zn(II) and Cu(II) complexes of one ligand show one-dimensional coordination polymers, with the acetate groups of the ligand bridging two metal centers. The structural characterization of complexes of other metal ions, including tri-valent and di-valent metals, is being pursued for the photochemical purposes as well as understanding the factors that promote the formation of the coordination polymers.

(49) Nonequilibrium Systems of Carbodiimides Driven Dissipative Aqueous Carboxylic Acid Anhydrides

Hehe (Frank) Wang, Lasith S. Kariyawasam, Isuru M Jayalath W., and C. Scott Hartley

Department of Chemistry and Biochemistry, Miami University, Oxford, Ohio 45056.
Self-assembly is the autonomous construction of organized structures or patterns from smaller components. Static self-assembly (SSA) and dissipative self-assembly (DSA) are the two kinds of self-assembly. SSA system is at local equilibrium and do not dissipative energy. DSA system is not at thermodynamic equilibrium and requires continuous energy input to persist. Our project is aiming to study the dissipative covalent bond formation between organic compounds in aqueous solution. Specifically, carboxylic acid anhydrides are interested in this study. This DSA system is driven by carbodiimides as the chemical fuel. We have studied the structure property of anhydride formation in diphenic acid and its derivatives by $^1$H NMR spectroscopy, IR spectroscopy.

(50) Plastic flexible plasmonic substrate

Jamison Reifsteck, Jie He, Ian Bruzas, and Laura Sagle

Department of Chemistry, The University of Cincinnati, Cincinnati, OH 45221

Plasmonic on-chip devices are widely used in a variety of fields. The most common substrates are mostly focused on glass or silica wafers, which are ridged, fragile, and expensive. Using HMLC (hole-mask colloidal lithography) fabrication of a gold nanoparticle array on a flexible plastic substrate is possible. HMLC’s rapid and inexpensive fabrication allows for tuneability in the shape, size, and spacing of the nanoparticles. Through stretching of the substrate midway through the fabrication, star and bean shaped nanoparticles have been observed, which has potential for high sensitivity for LSPR (localized surface Plasmon resonance) and SERS (surface enhanced raman spectroscopy) measurements. Additionally, by twisting the array it is possible to get a CD (circular dichroism) signal. HMLC allows for a cheap, tunable, rugged, and flexible device for biological sensing.

(51) Sensitive, selective, and quantitative copper sensor using click-chemistry with gold nanoparticles.

ReJeana Cary, Sarah Unser and Laura Sagle

Department of Chemistry, The University of Cincinnati, Cincinnati, OH 45221

Copper ions have been implicated to play an important role in the angiogenesis process, formation of new blood vessels, which is high in metastatic cancer. One potential treatment and prevention of breast
cancer metastasis is to deplete copper ions. However, before treatment, the concentration of copper ions must be accurately known, since too high or too low concentrations may cause damage to healthy cells. In order to detect copper ions in an inexpensive, rapid manner, we have developed a localized surface plasmon resonance (LSPR) assay in which a dye is attached to gold nanoparticles via copper dependent click chemistry.

(52) Signal Amplifiable Mercury Detection Method based on Upconversion Nanomaterials

Anjaly N. Vijayan, Peng Zhang*

Department of Chemistry, The University of Cincinnati, Cincinnati, OH

A novel upconversion method for mercury detection using modified DNA conjugated Upconversion nanoparticle is developed. The detection is based on formation of Thiamine-Hg^{2+}-Thiamine complex. The detection scheme is based on luminescence resonance energy transfer (LRET) between upconversion nanoparticles(UCNPs) and a fluorophore. The Hg^{2+} detection limit of this assay is in nanomolar range which is the US Environmental Protection Agency(EPA) limit of Hg^{2+} for drinkable water.

(53) A Novel Spectroelectrochemical Biosensing Scheme

Michael E. Smith, William R. Heineman, Peng Zhang

Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221–0172 USA

Electrochemical biosensors that employ metal nanoparticles (NPs) as labels have drawn considerable interest in recent years largely due to advantages such as easy method operation, high selectivity, and simple instrumentation suitable for portable devices. However, a major drawback with these schemes is that the limits of detection (LODs) are often not suitable for clinical sample analyses. To overcome this drawback, we propose a novel spectroelectrochemical biosensing scheme.

(54) Ion Pair Reactions in the High Speed Ball Mill
Lianna N Ortiz-Trankina, Jazmine Crain, Carl Williams III, James Mack*

Department of Chemistry, The University of Cincinnati, Cincinnati, OH

A solvent-free, acid-base condition has been developed to investigate the significance of ion pairing for driving forward nucleophilic substitution reactions in the high speed ball mill (HSBM). This approach takes advantage of the lack of solvent shells to incorporate weaker and safer bases to drive reactions to completion through specific ion pair pathways. The most efficient reactions contained larger and more polarizable cation and anion pairs.

(55) Shaken, Not Stirred: Mechanochemical Reductions of α-β Unsaturated Carbonyls

Matthew McDaniel, Joel Anderson, Daniel Waddell, and James Mack*

Department of Chemistry, The University of Cincinnati, Cincinnati, OH

Many people imagine chemists surrounded by beakers and flasks of chemicals being stirred as reactions occur. Considering the millions of pounds of solvent waste produced annually, Mechanochemists have begun to explore new ways to perform reactions without these solvents, using a ball mill to pulverize chemicals and provide the energy needed for them to react. As we look into these greener ways to achieve old reactions, it’s important to explore the selectivity of them in this new environment. This study examines the selective reductions of α-β unsaturated carbonyls in the ball mill including surprising results in the reduction of amides.

(56) Reversible addition-fragmentation chain transfer (RAFT) polymerization using a Chain Transfer Agent (CTA) bearing a Fluorine atom in the Z Position

Brett Bolton, Neil Ayres

Department of Chemistry, The University of Cincinnati, Cincinnati, OH

RAFT is a reversible deactivation radical polymerization technique that uses a chain transfer agent (CTA) to afford polymers with complex architectures, predetermined molecular weights, and narrow dispersities. In this work, we have synthesized a fluorine-containing CTA, 1-cyano-1-cyclohexylfluorodithioformate, to control the polymerizations of monomers with disparate reactivities.
Specifically, we have polymerized N-vinylformamide (Dispersity, $D_r = 1.37$), methyl acrylate ($D = 1.02$) and styrene ($D = 1.15$). This represents the first, to our knowledge, successful demonstration of “F-RAFT” controlled polymerization of a wide array of monomers.

(57) **Gelatin based dynamic hydrogels via thiol-norbornene reactions**

Mario Perera, Neil Ayres  
Department of Chemistry, The University of Cincinnati, Cincinnati, OH

Gelatin based dynamic hydrogels were prepared by crosslinking norbornene functionalized gelatin with poly(2-hydroxypropyl methacrylate-s-mercaptoethyl methacrylate) (poly(HPMA-s-MEMA)) using radical mediated thiol-norbornene reactions. The poly(HPMA-s-MEMA) was prepared from a pyridyl disulfide functionalized poly(2-hydroxypropyl methacrylate-s-pyridyldisulfide ethylmethacrylate) (poly(HPMA-s-PDSEMA)) copolymer, which was synthesized using reversible addition fragmentation chain transfer (RAFT) polymerization. Subsequent reduction of the polymer afforded a copolymer with pendent thiol groups. The swelling ratio and storage moduli ($G'$) of the hydrogels were controlled by varying the thiol/ene molar ratio. Increases in material properties were observed with increasing thiol/ene molar ratio due to the formation of disulfide crosslinks in addition to the alkyl sulfide crosslinks. Thiol exchange reactions with 2-mercaptoethanol were used to soften the hydrogel. Inversely, hydrogel stiffening was achieved through secondary thiol-norbornene cross-linking between PEG-diNB and free thiols in the hydrogel. The hydrogels demonstrate controllable stiffness over a 9.5 kPa – 17.8 kPa range. These hydrogels are candidates for studying dynamic cell processes, for example fibrosis.

(58) **A New Method in Organophosphate Synthesis**

Emily Granger, Katarzyna Solomianko, Cori Young, Jeremy M. Erb  
University of Dayton

The synthesis of complex organophosphates is a challenging task, especially if control of a chiral phosphorus center is desired. Despite this, organophosphates have recently been found to have an important role in pharmaceuticals. Our research group has focused on exploring the use of both Lewis
acid and nucleophilic based catalysts to synthesize organophosphates from the commonly available phosphorus oxychloride through a triple substitution using alcohols. Our results indicate that although stereochemistry has proven hard to control, MgSO₄ can be used to moderately improve the chemical yield of these compounds (yields can be up to 36% higher vs. the uncatalyzed yield).

(59) Radical Coupling Reactions of Amines and Ketones Using Fenton’s Reagent

Kathyrn B. Mapes¹, Nathan D. Ranly², Richard P. Hotz¹, Allan R. Pinhas²

¹Department of Chemistry, Mount St. Joseph University
²Department of Chemistry, University of Cincinnati

Using Fenton’s reagent, both amines and ketones undergo radical coupling reactions. Under acidic Fenton conditions, a ketone’s enol form predominates thus, methyl ketones do not couple at the α-carbon. Variations in time, temperature, and pH do not shift the equilibrium back towards the keto tautomer. It is proposed that keto radicals couple with enols to produce diketone products. The dimer product yield in amine coupling is optimal in an extreme excess of Fenton's reagents and short time. Prolonged exposure to this excess leads to tri- and tetramerization products. Highly acidic conditions increase specificity at the terminal ethyl carbon in triethylamine.