

# Department of Chemistry and Biochemistry

## Faculty Research Areas

# Poop! There it is! Prophylaxis and Biological Variables Affecting Intestinal Bacterial Infections

- **Dr. Ernesto Abel-Santos**
- Professor
- Department of Chemistry & Biochemistry
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## Expertise

- Bioorganic chemistry
- Enzymology
- Bacterial Spore Germination
- Bioterrorism



# Inhibition of *C. difficile* spore germination protects mice from infection

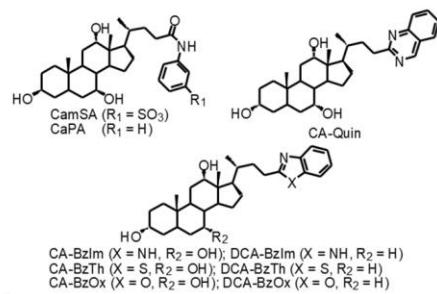
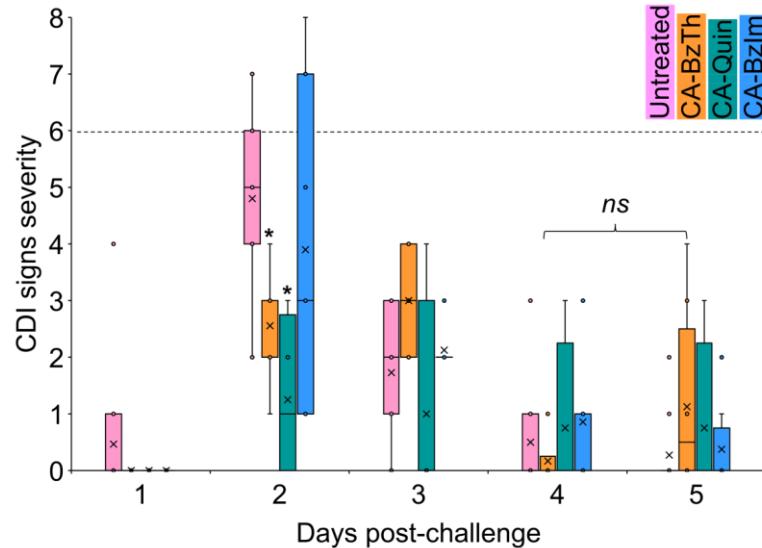
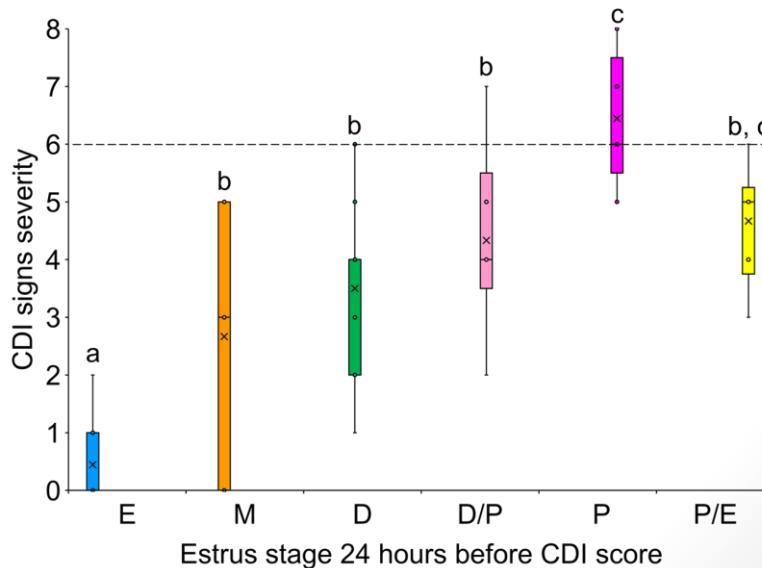
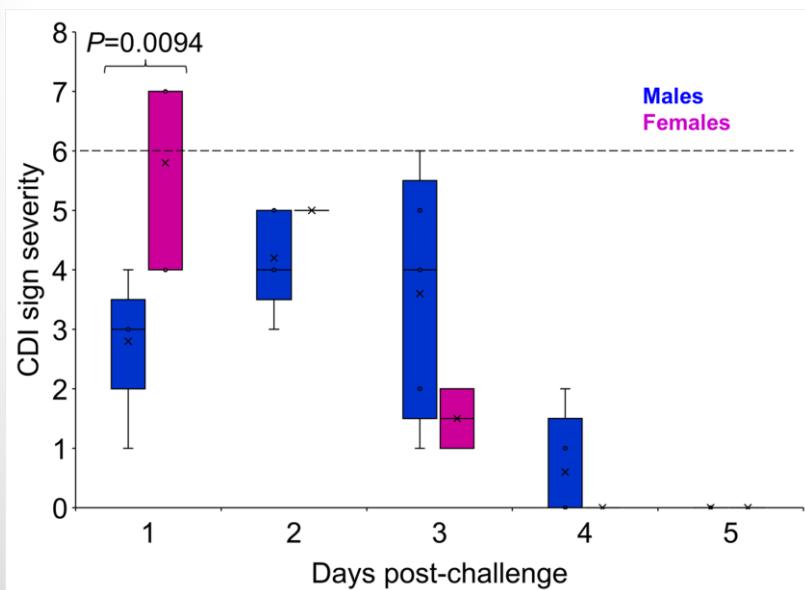


Table 1. NHBS-mediated germination inhibition of <i>C. difficile</i> strain R20291 spores	
Name	IC <sub>50</sub> ( $\mu M$ )
CA-Quin	21.6 $\pm$ 2.6
CA-BzIm	4.4 $\pm$ 0.3
DCA-BzIm	5.6 $\pm$ 1.2
CA-BzTh	5.9 $\pm$ 3.5
DCA-BzTh	Inactive
CA-BzOx	5.8 $\pm$ 2.8
DCA-BzOx	Inactive



## *C. difficile* infection severity in mice is affected by their estrus cycle



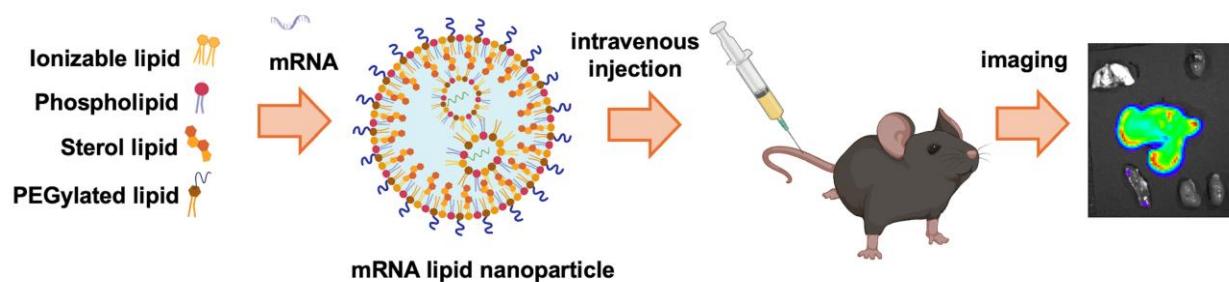
# mRNA medicine

- **Dr. Chandrabali Bhattacharya**
- Assistant Professor
- Department of Chemistry and Biochemistry
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## Expertise

- Biomaterials
- Drug and Gene Delivery
- Chemical Biology
- Medicinal Chemistry



Our interests focus on organic and polymer synthesis in general. More specifically, we are interested in developing novel light-emitting and liquid-crystalline polymers for their multitude applications in modern technology, including biosensors.

In another project, we are developing ionic liquids and ionic liquid crystals for their better ionic conductivities as electrolytes for next generation batteries. Significant efforts are concentrated on the development organic ionic plastic crystals for the solid state batteries.

Carbon nanotube-based composite materials based on ionic polymers are of significant interest in our group. In recent years, we are also actively pursuing the development of cisplatin analogs for cancer therapy.



Colorful Pyrylium Salts



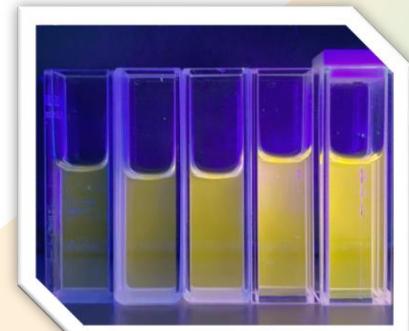
Liquid Crystalline Texture



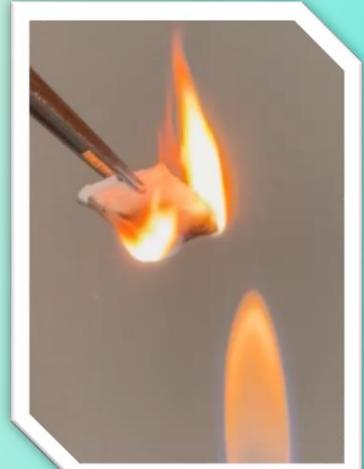
Fluorescent Pyrylium  
Solution

## Current Research Interests

- Thermotropic and Lyotropic Liquid Crystalline Polymers
- Polyesters, Viologen Polymers, Poly(pyridinium salt)s
- Fire Retardant Polymers
- Light-Emitting Properties of Polymers
- Photo-responsive Polymers
- Proton and Anion Exchange Membranes
- Oxidation of Carbohydrates by Viologens
- Ionic Liquids, Liquid Crystals, and Plastic Crystals
- Novel Light-Harvesters for Solar Energy Storage
- Fluorescent Molecules for Cell Imaging
- Pyrylium Salt Chemistry
- Lasing Properties in Organic Solvents and Water
- Two Photon Induced Absorption Fluorescent Properties
- Piezochromic Materials
- Magnetic Materials
- Cisplatin Analogues for Cancer Therapy



Polymer  
Flame  
Testing



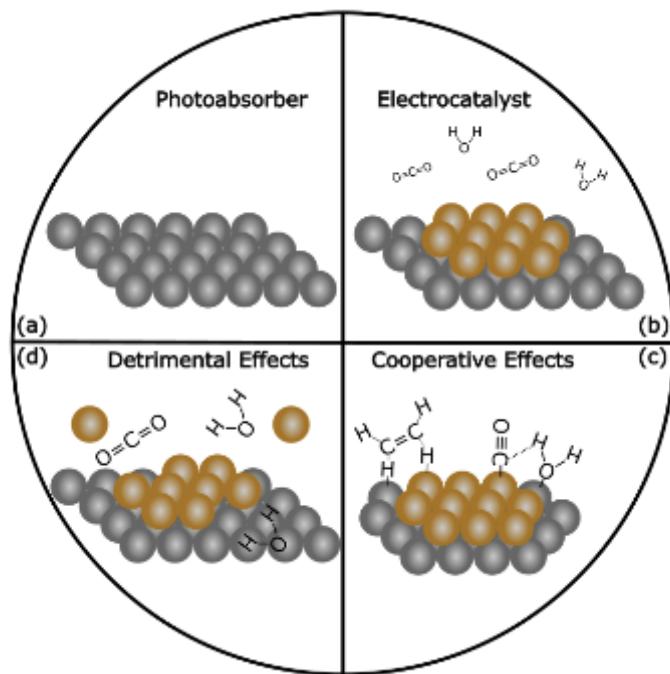
# Interfacial Photochemistry

- **Dr. Jared P. Bruce**
- Assistant Professor
- Department of Chemistry and Biochemistry
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- Website: [jpbruce.fas.unlv.edu](http://jpbruce.fas.unlv.edu)

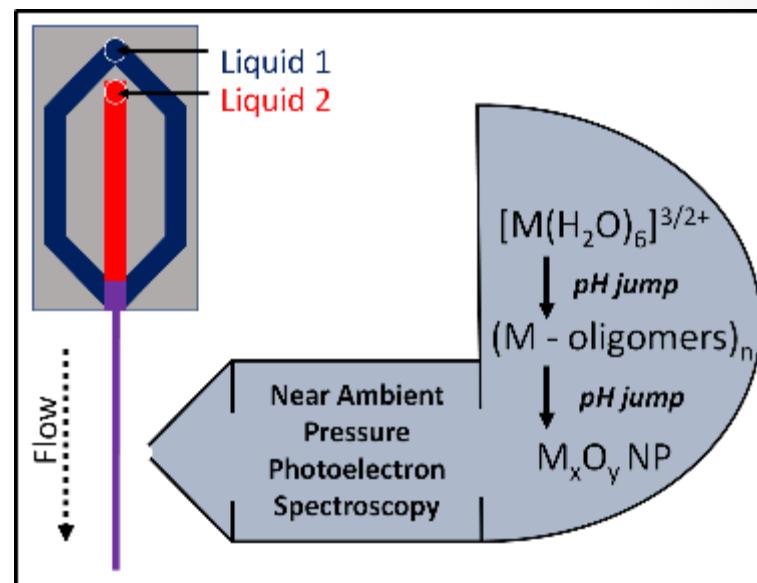
## Expertise

- Heterogeneous Photochemistry
- Electrocatalysis
- Photocatalysis
- Atmospheric Chemistry
- Surface Chemistry and Interfacial Characterization
- Near Ambient Pressure Photoelectron Spectroscopy

## Hybrid Co-Catalyst/Photoabsorber Photochemical Interfaces



## Mixing Liquid Jet Photoelectron Spectroscopy



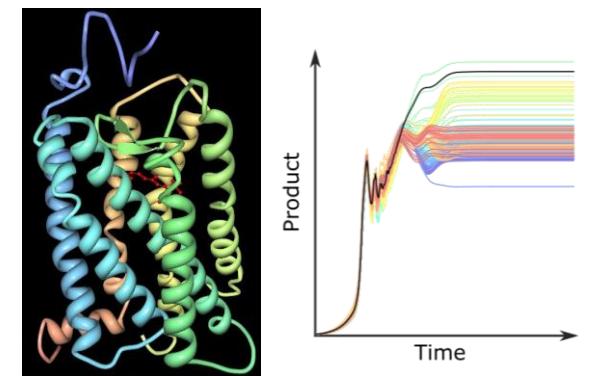
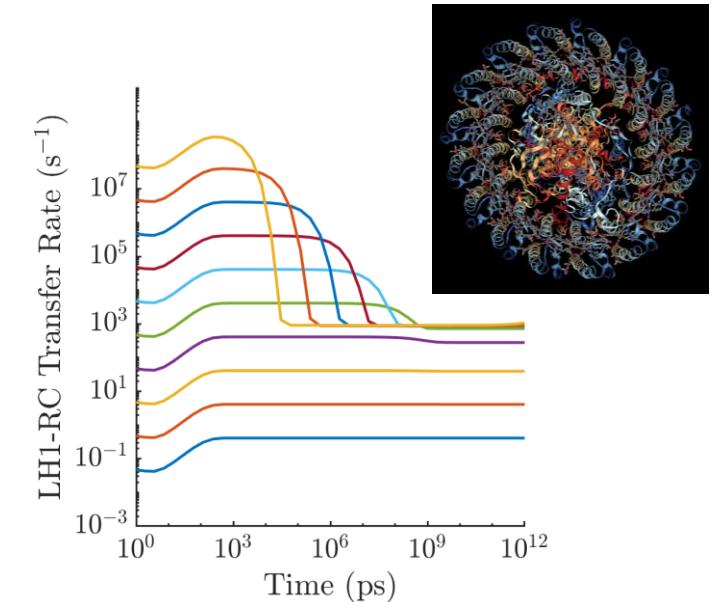
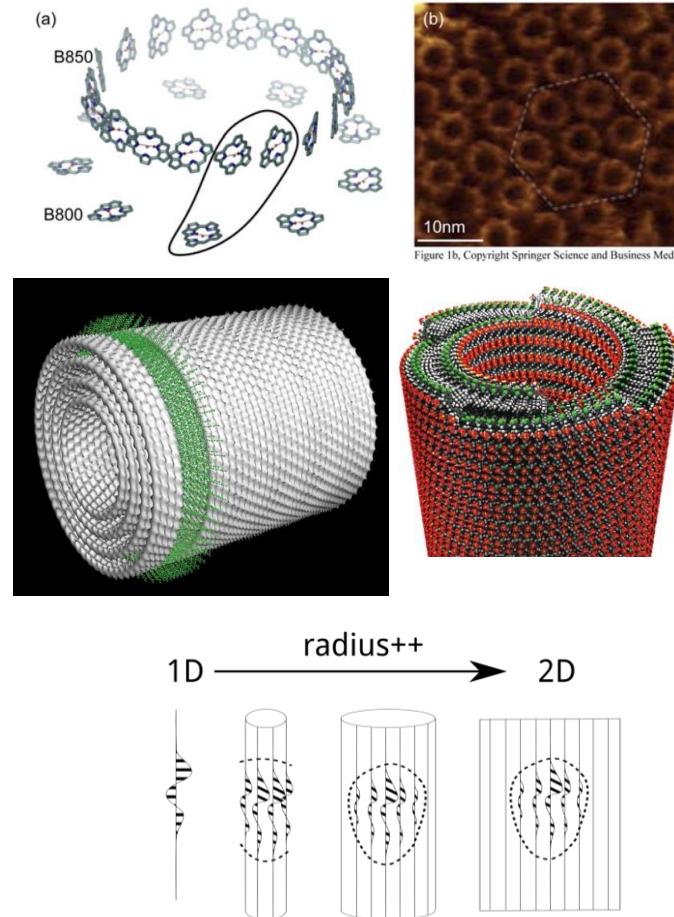
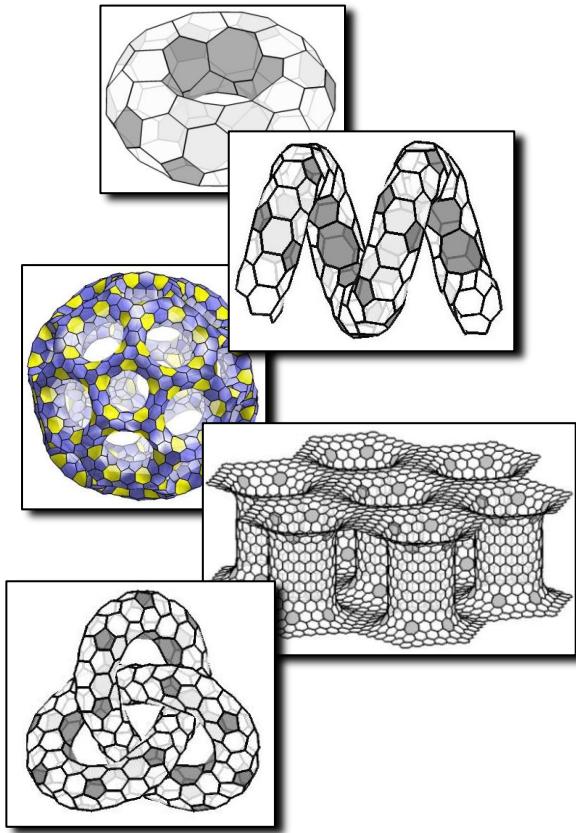
- Metals often make good electrocatalysts
- Semiconductors make good photoabsorbers
- The combination of the two create a new, complex interface that can be leveraged to increase the efficiency of co-catalyst/photoabsorber devices

- Dynamic processes are tricky to study at the liquid surface
- A small liquid jet (20 $\mu$ m dia.) is used to investigate the liquid surface
- Microfluidic chips provide mixing chamber to induce chemical reactions

# Theoretical chemical physics

- Dr. Chern Chuang,
- Assistant Professor, Department of Chemistry and Biochemistry
- Email: [chern.chuang@unlv.edu](mailto:chern.chuang@unlv.edu)
- Website: <http://cchuang.faculty.unlv.edu/Home.html>
- Expertise
  - Open quantum system dynamics and spectroscopy
  - Photophysics and photochemistry of materials
  - Quantum transport
  - Quantum effects in biology
  - Exotic geometries and topologies of low dimensional materials

# Theoretical chemical physics



Exotic low-dimensional materials

Photophysics of organic materials

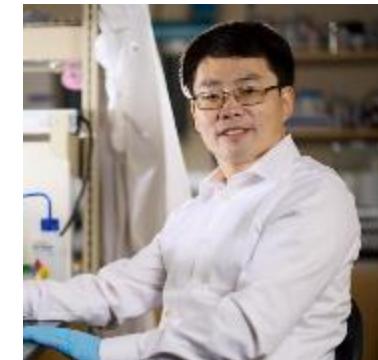
Photochemistry under environmental control

# Electrochemistry for Energy Storage, Environmental Remediation, and Biomedical Applications

- **Dr. Zchange Feng**
- Assistant Professor
- Department of Chemistry & Biochemistry
- Email: [zhange.feng@unlv.edu](mailto:zhange.feng@unlv.edu)
- Website: <https://zfeng.faculty.unlv.edu/>

## Expertise

- Water and soil remediation
- Rechargeable batteries
- Electrocatalysis
- Electrosynthesis
- Electrochemical Manufacturing
- Electrical neural stimulation



**A combination of electrochemistry, *in situ* spectroscopy, and theoretical calculations to study electrified interfaces**

# Radiochemistry

Paul M. Forster

Department of Chemistry and Biochemistry  
Radiochemistry

# Expertise:

-Structure determination (X-ray and neutron diffraction, total scattering)

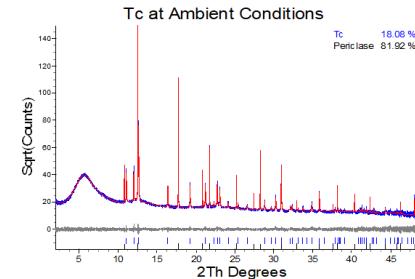
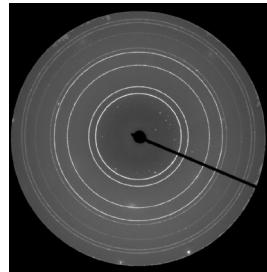
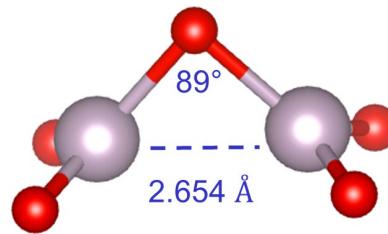
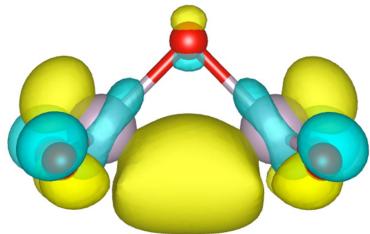


Figure 1 One-hour XRD of technetium metal and magnesium oxide.

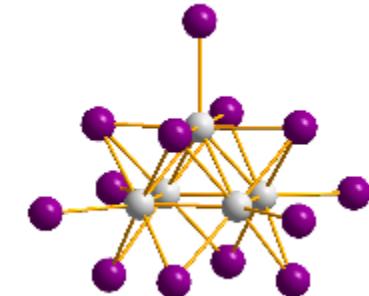
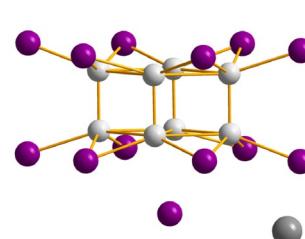
-Structure-property relationships, integrated simulation



Probable identification of a gas phase technetium oxide molecule

-Hydro/solvothermal synthesis

Technetium iodide compounds prepared solvothermally



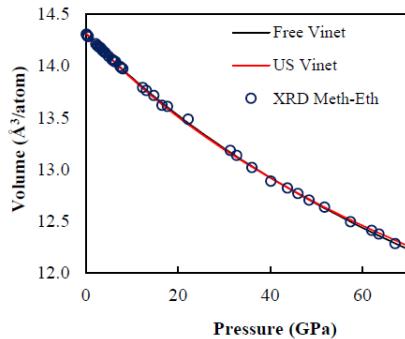
Paul M. Forster

Department of Chemistry and Biochemistry  
Radiochemistry

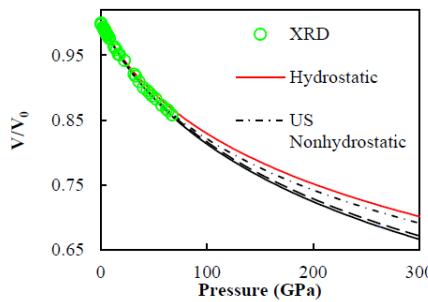
# Relevant projects:

## First diffraction-based equation of state for elemental Tc

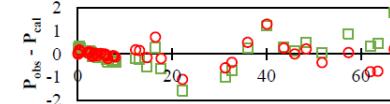
a) EOS of technetium



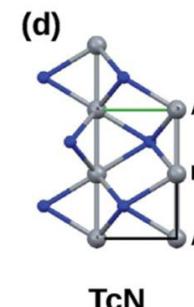
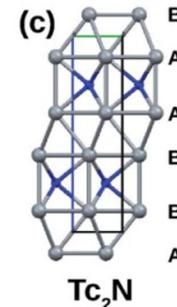
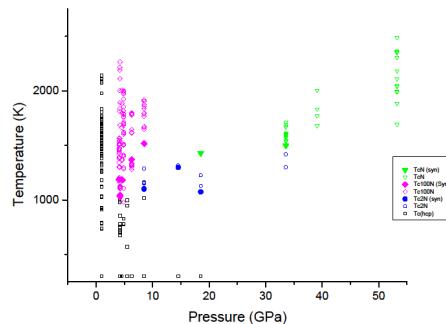
b) EOS of technetium



c) Pressure Difference



## Discovery of new binary Tc nitrides



Paul M. Forster

Department of Chemistry and Biochemistry  
Radiochemistry

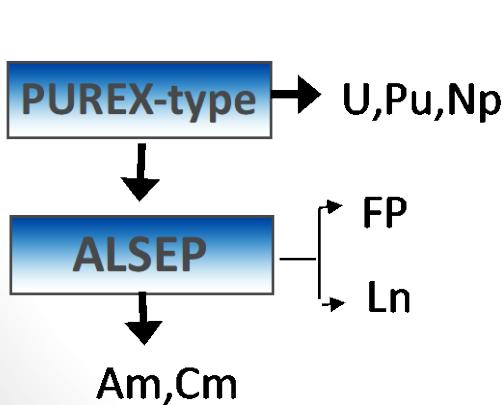
# Art Gelis

## Director, Radiochemistry Program

Actinide Separations and Recovery

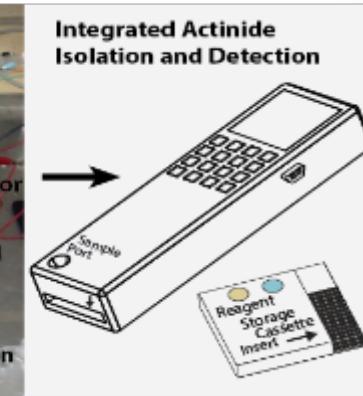
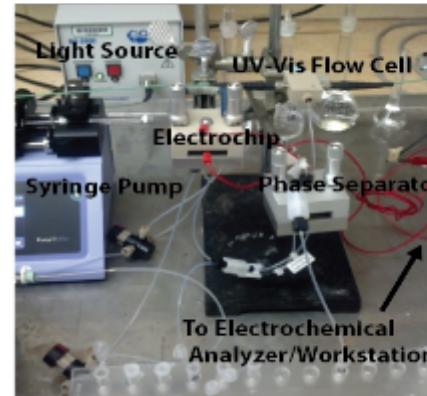
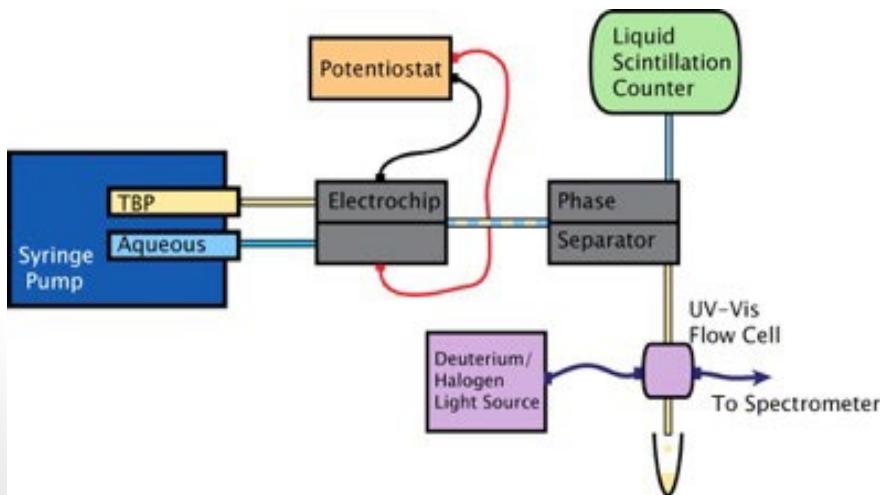
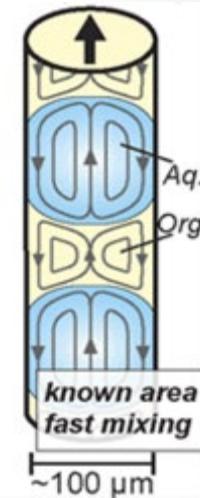
# Design and Testing of Advanced Separation Processes using Additive Manufacturing

- Liquid-Liquid Extraction and Separation of Plutonium, Uranium, Minor Actinides, Lanthanides and Fission Products
- Twenty-seven 3D-printed acrylic centrifugal contactors (CC), fabricated at Argonne National Lab are available at UNLV
- Contactors can be 3D-printed in stainless steel or any alloy
- Solvent extraction separations can be tailored to a specific goal
- Example: **Actinide Lanthanide SEParation process - ALSEP**, designed and tested for DOE-NE

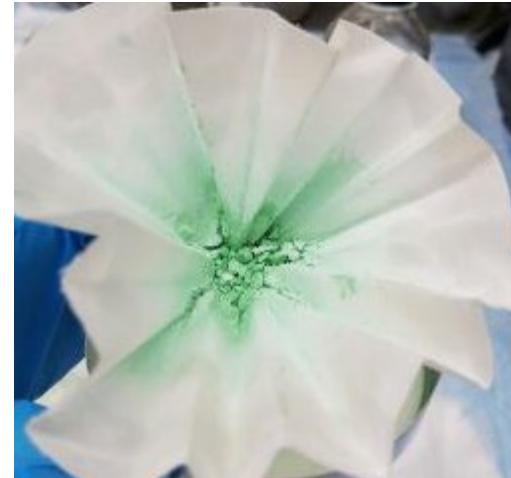
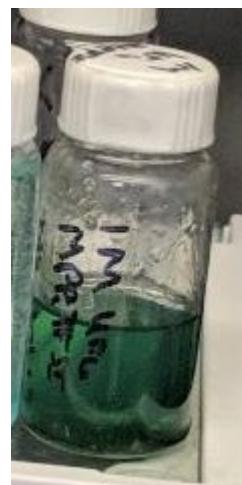


# Microfluidic Systems for Rapid Radionuclide Separation and Detection

- Microfluidic device to combine aqueous and organic phases, rapidly mix, then separate phases, following by analysis
- Selective Extraction of radionuclides on a very small scale
- Can be implemented either as a bench-top setup or as a portable detector
- Potential applications: rapid Pu separation and detection from Uranium and FP for safeguards; "dirty bomb" analysis



# Strategic Materials Analysis and Recovery – David Hatchett and Ken Czerwinski

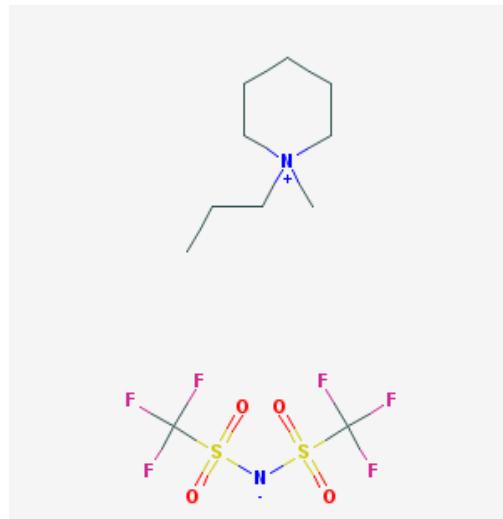


**Dissolution of  $\text{UF}_6$  into IL at 0 hours, 24 hours, 30 days, and the recovery of  $\text{UF}_6$  salt.**

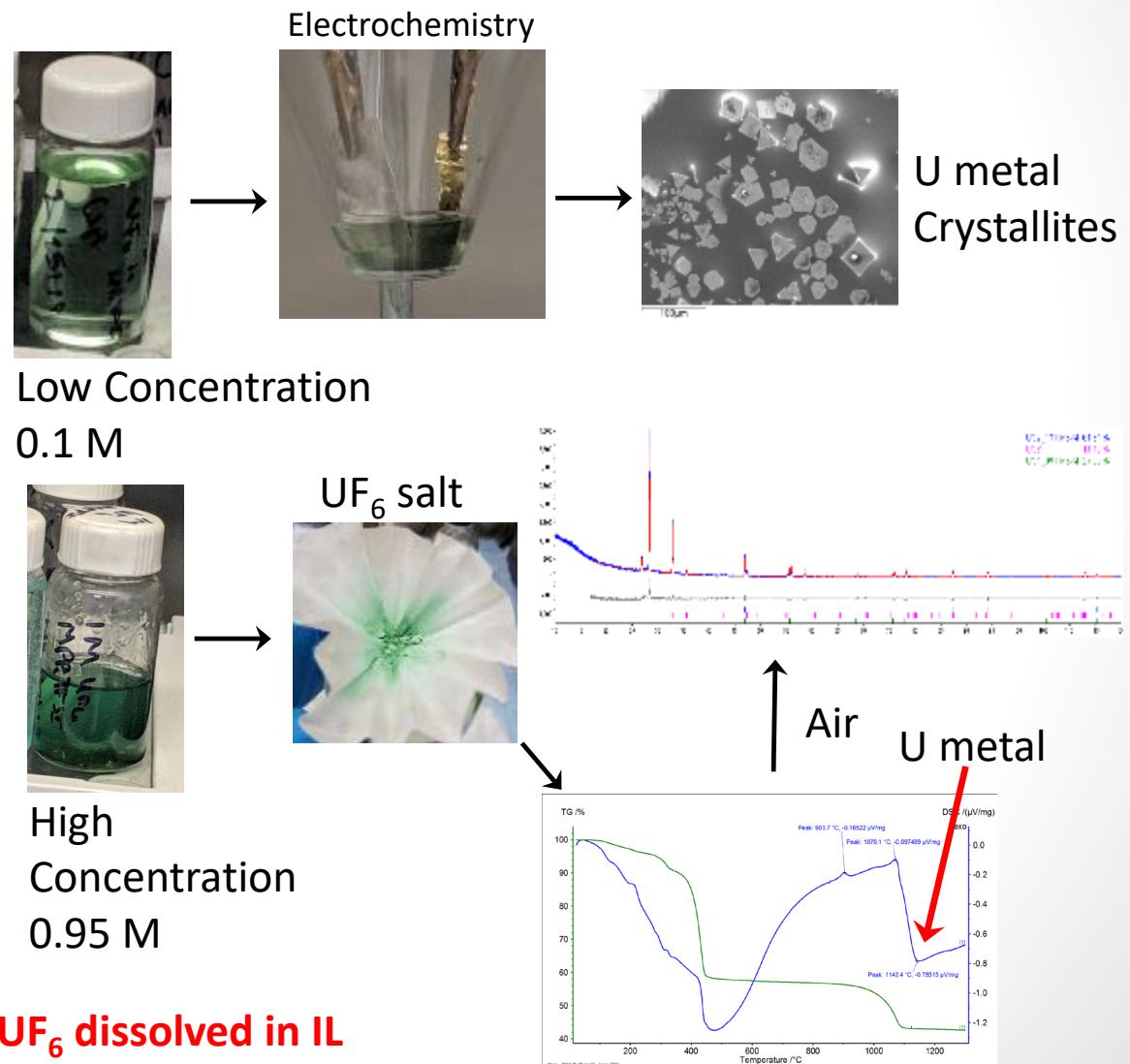
## Expertise:

- Actinide, Lanthanide, and Li materials recovery from Ionic Liquids (ILs).
- Electrochemical, Spectroscopic, and thermal analysis of Radioactive materials.
- Radiochemistry and Analytical Chemistry.

# Strategic Materials Analysis and Recovery – David Hatchett and Ken Czerwinski



$\text{UF}_6 + 2 \text{TFSI}^- \rightarrow \text{UF}_6^{2-} + 2 \text{TFSI}^-$   
[MPPi]<sub>2</sub>[UF<sub>6</sub>]  
UF<sub>6</sub> salt



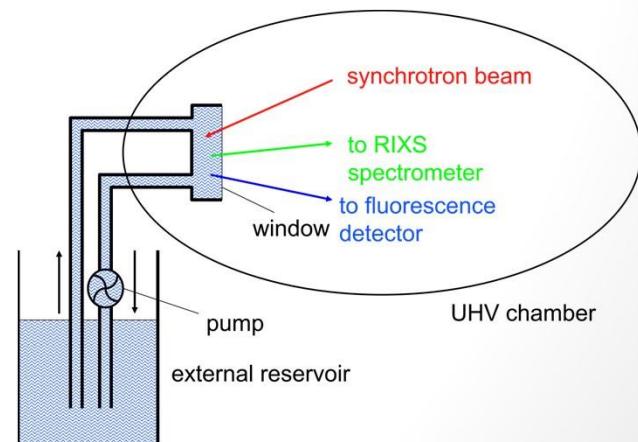
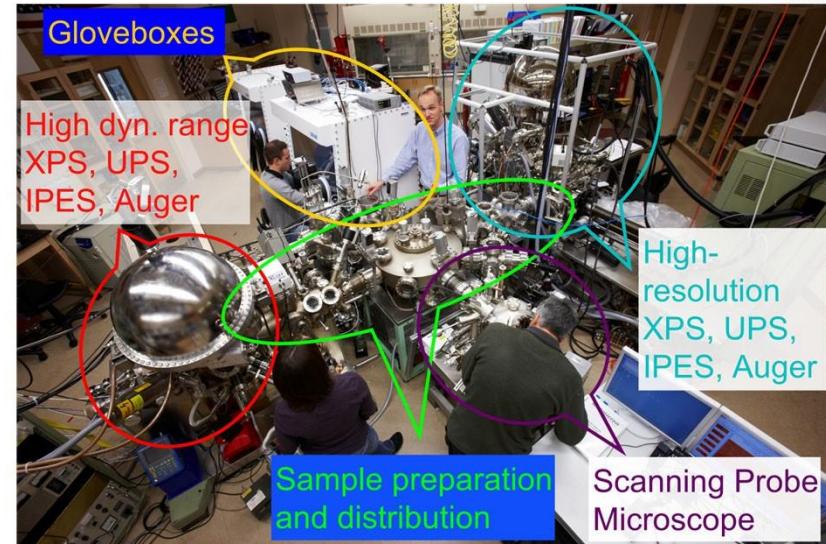
Paths to U recovery from UF<sub>6</sub> dissolved in IL

# Surface and Interface Characterization of Materials for Energy Conversion

- **Dr. Clemens Heske**
- Professor
- Department of Chemistry and Biochemistry
- Email: [heske@unlv.nevada.edu](mailto:heske@unlv.nevada.edu)
- Website: <https://heske.faculty.unlv.edu/>

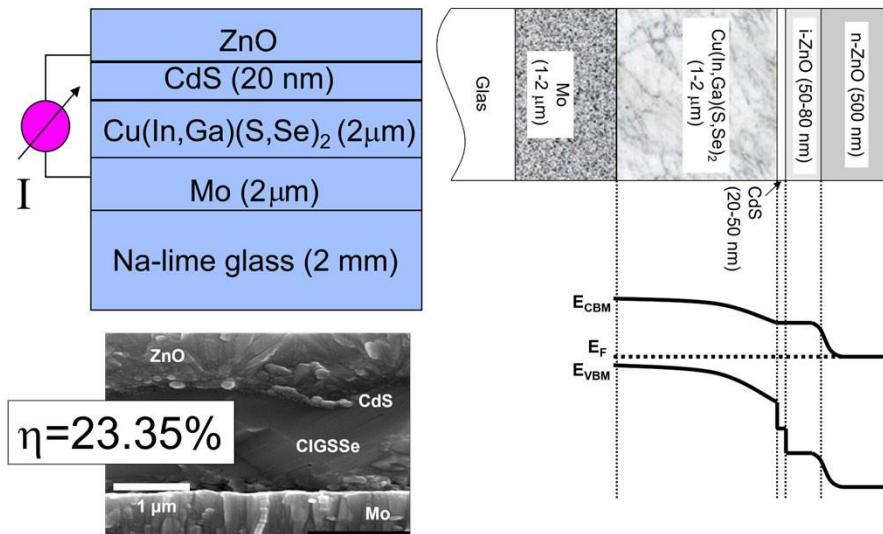
## Expertise

- Electronic and Chemical Structure of Energy-Conversion Materials
- Surface and Interface Characterization
- Soft x-ray and Electron Spectroscopy
- Scanning Probe Microscopy
- Synchrotron Radiation

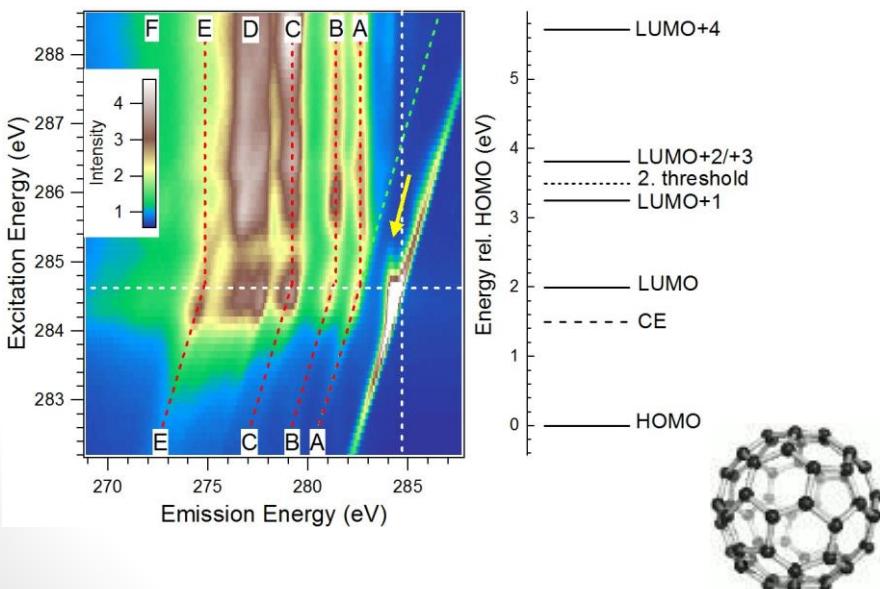


# Surface and Interface Characterization of Materials for Energy Conversion

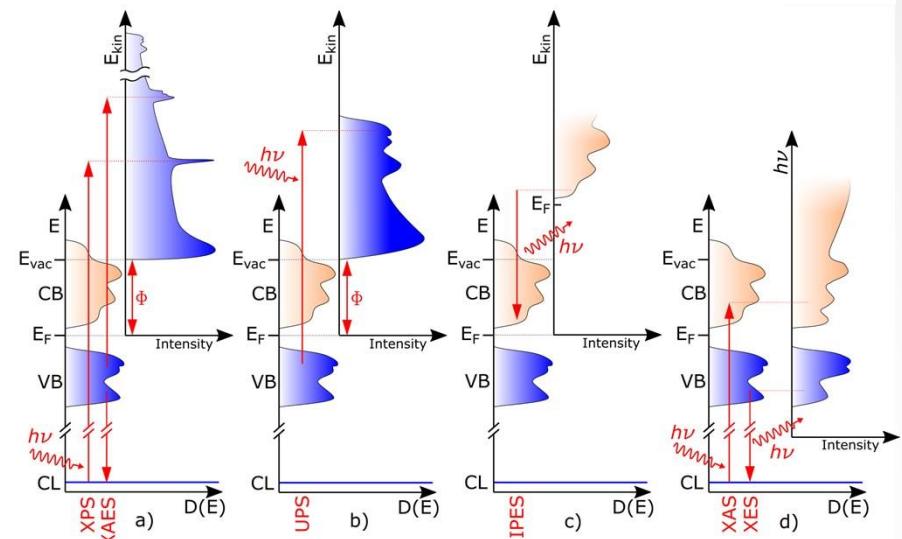
## Cu(In,Ga)(S,Se)<sub>2</sub> Thin-Film PV Device



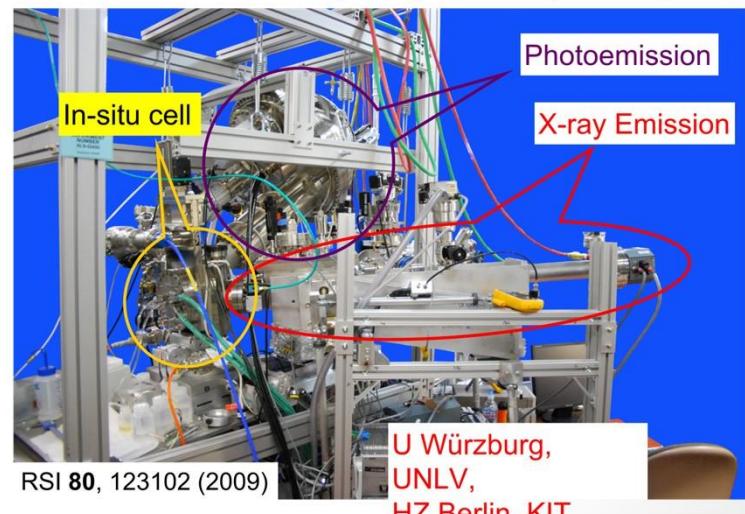
## Electronic structure of C<sub>60</sub>



## Method development



## SALSA: Solid And Liquid Spectroscopic Analysis



# Main-Group and Organometallic Chemistry

- **Dr. Arumugam Jayaraman**
- Assistant Professor, Inorganic Chemistry
- Department of Chemistry and Biochemistry
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## Expertise

- Chemistry of Low-valent Boron, Carbon and Phosphorus Compounds
- Antiaromatic and Aromatic Main-Group Heterocyclic Materials
- Sustainable Transformation of Burnt Fossil Fuels to Chemical Feedstock
- Green Catalysis and Technology Transfer to Fine-Chemical Industry
- Synthetic Inorganic Antibiotics
- Computational Organometallic Chemistry of *p*- and *d*-block compounds
- Single-Crystal X-ray Crystallography

## Selected Publications

- 1) *Olefin  $\pi$ -coordination chemistry at low-oxidation-state boron*, M. Michel, M. Weber, A. Jayaraman, R. D. Dewhurst, I. Krummenacher, C. Voigt, M. Härterich, A. Vargas, H. Braunschweig, [Nature Chem.](#), 2025, in press.
- 2) *Formation and metallomimetic reactivity of a transient dicoordinate alkylborylene*, Y. Konrad, A. Jayaraman, I. Krummenacher, H. Braunschweig, [Angew. Chem. Int. Ed.](#), 2025, e202423669
- 3) *Straightforward formation of borirenes from boroles and dialkynes*, P. H. R. Oliveira, M. O. Rodrigues, C. D. G. Da Silva, J. L. Bohlen, M. Arrowsmith, A. Jayaraman, L. Lubczyk, F. Fantuzzi, E. N. da Silva Júnior, H. Braunschweig, [Angew. Chem. Int. Ed.](#), 2025, e202423391
- 4) *Intermolecular 1,2-aminoboration of alkynes and the critical role of electron-rich alkynes*, S. Dotzauer, A. Jayaraman, D. Reinhart, H. Braunschweig, [Angew. Chem. Int. Ed.](#), 2024, 63, e202413370
- 5) *Experimental observation of a terminal borylene-dinitrogen adduct via cleavage of a 1,2,3,4,5-diboratriazoline*, A. Jayaraman, B. Ritschel, M. Arrowsmith, C. Markl, M. Jürgensen, A. Halkić, Y. Konrad, A. Stoy, K. Radacki, H. Braunschweig, [Angew. Chem. Int. Ed.](#), 2024, 63, e202412307
- 6) *Full electron delocalization across the cluster in 1,12-bis BMes<sub>2</sub>-p-carborane radical anion*, L. Wu, X. Zhang, M. Moos, I. Krummenacher, M. Dietz, A. Jayaraman, R. Bertermann, Q. Ye, M. Finze, C. Lambert, H. Braunschweig, L. Ji, [J. Am. Chem. Soc.](#), 2024, 146, 17956–17963
- 7) *An unsymmetrical, cyclic diborene based on a chelating CAAC ligand and its small-molecule activation and rearrangement chemistry*, W. Lu, A. Jayaraman, F. Fantuzzi, R. D. Dewhurst, M. Härterich, M. Dietz, S. Hagpiel, I. Krummenacher, K. Hammond, J. Cui and H. Braunschweig, [Angew. Chem. Int. Ed.](#), 2022, 61, e202113947
- 8) *Palladium-catalyzed homocoupling of highly fluorinated arylboronates: studies of the influence of strongly vs weakly coordinating solvents on the reductive elimination process*, Y. Budiman, A. Jayaraman, A. Friedrich, F. Kerner, U. Radius, T. B. Marder [J. Am. Chem. Soc.](#), 2020, 142, 6036–6050
- 9) *Practical and scalable synthesis of borylated heterocycles using stable precursor of metal-free Lewis pair catalysts*, A. Jayaraman, L. C. Misal Castro, F.-G. Fontaine, [Org. Process Res. Dev.](#), 2018, 22 (11), 1489–1499
- 10) *Metal-free borylation of heteroarenes using ambiphilic aminoboranes: on the importance of sterics in frustrated Lewis pair C-H bond activation*, J. L. Lavergne, A. Jayaraman, L. C. Misal Castro, É. Rochette, F.-G. Fontaine, [J. Am. Chem. Soc.](#), 2017, 139 (41), 14714–14723
- 11) *A potent synthetic inorganic antibiotic with activity against drug-resistant pathogens*, S. Hubick, A. Jayaraman, S. Reid, J. Alcorn, J. Stavrinides, B. T. Sterenberg, [Sci. Rep. \(Nature\)](#), 2017, 7, 41999

# Jun Yong Kang

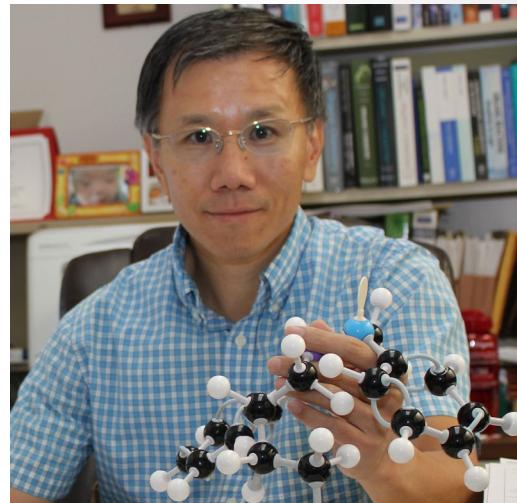
- Assistant Professor, Department of Chemistry and Biochemistry
- Ph.D., Chemistry, Texas A&M University, College Station, TX
- CHE 217B, junyong.kang@unlv.edu
- [http://jkang.faculty.unlv.edu/?page\\_id=110](http://jkang.faculty.unlv.edu/?page_id=110)

## Areas of Expertise

- Synthetic organic chemistry
- Development of new synthetic methodology
- Asymmetric organocatalysis
- Organophosphorus chemistry
- Synthesis of bioactive small molecules

## Research Summary:

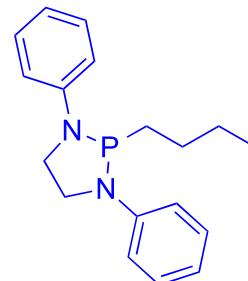
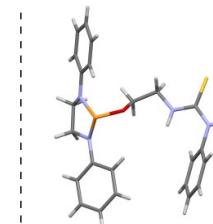
The development of new synthetic methodologies plays a key role in medicinal chemistry, biochemistry, and materials chemistry. Professor Kang and his group have been developing novel synthetic transformation and new chemical reagents such as commercially available NHP-thiourea and NHP-butane to apply for pharmaceuticals and bioactive molecules.



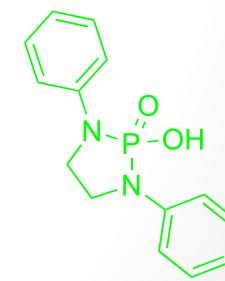
Kang's reagents-commercially available at Kerafast



**NHP-thiourea**  
(phosphonylation reagent)



**NHP-butane**  
(organocatalyst)



**NHPA**  
(organocatalyst)

# Ubiquitin-mediated protein degradation

Dr. Gary Kleiger

Professor and department Chair

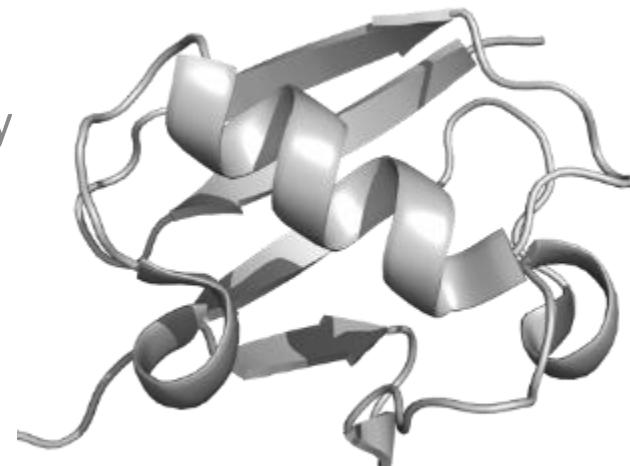
Department of Chemistry and Biochemistry

[gary.kleiger@unlv.edu](mailto:gary.kleiger@unlv.edu)

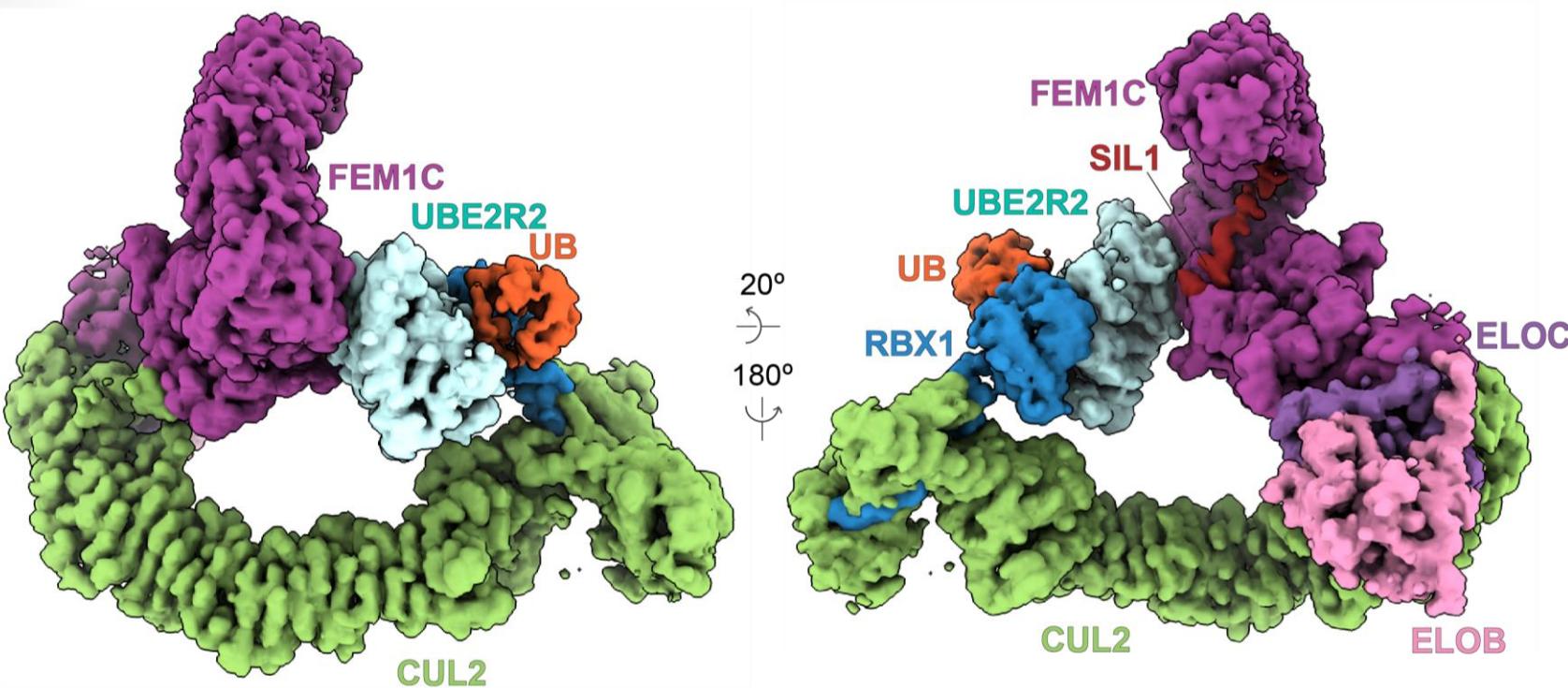
<https://kleiger.faculty.unlv.edu>

## Expertise

- Structural biology
- Proteomics
- Enzyme kinetics and biophysical assays
- Cell biology

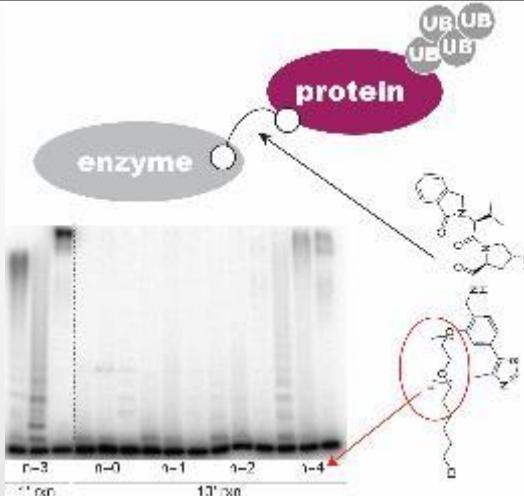
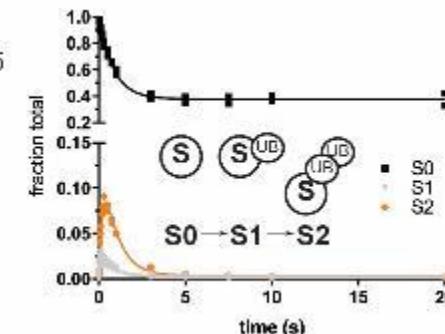
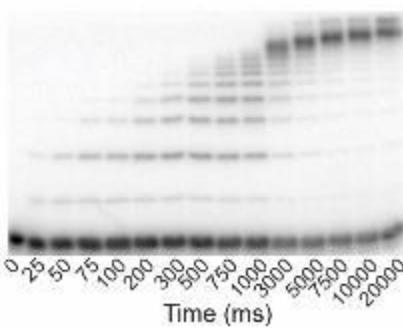


# Determining the structures of enzymes that promote protein degradation by cryo-EM.



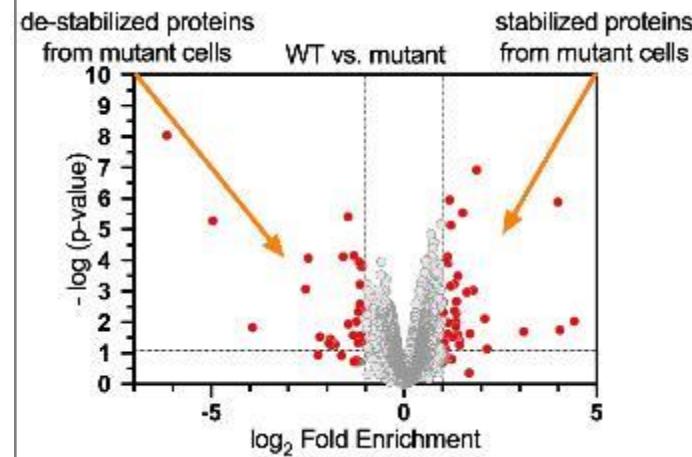
# Uncovering how the enzymes that promote protein degradation function in human cells.

Kinetics help us understand how enzymes select protein targets for modification with ubiquitin.



Small molecule inducers of protein degradation can be used to treat human disease. We study the mechanism of how they function both in test tubes and cells.

High-resolution mass-spectrometry tells us how mutations in enzymes that lead to human disease affect the stabilities of key human cellular proteins.



# Organic Materials Chemistry

## Dong-Chan Lee, Ph.D.

Associate Professor

Department of Chemistry & Biochemistry

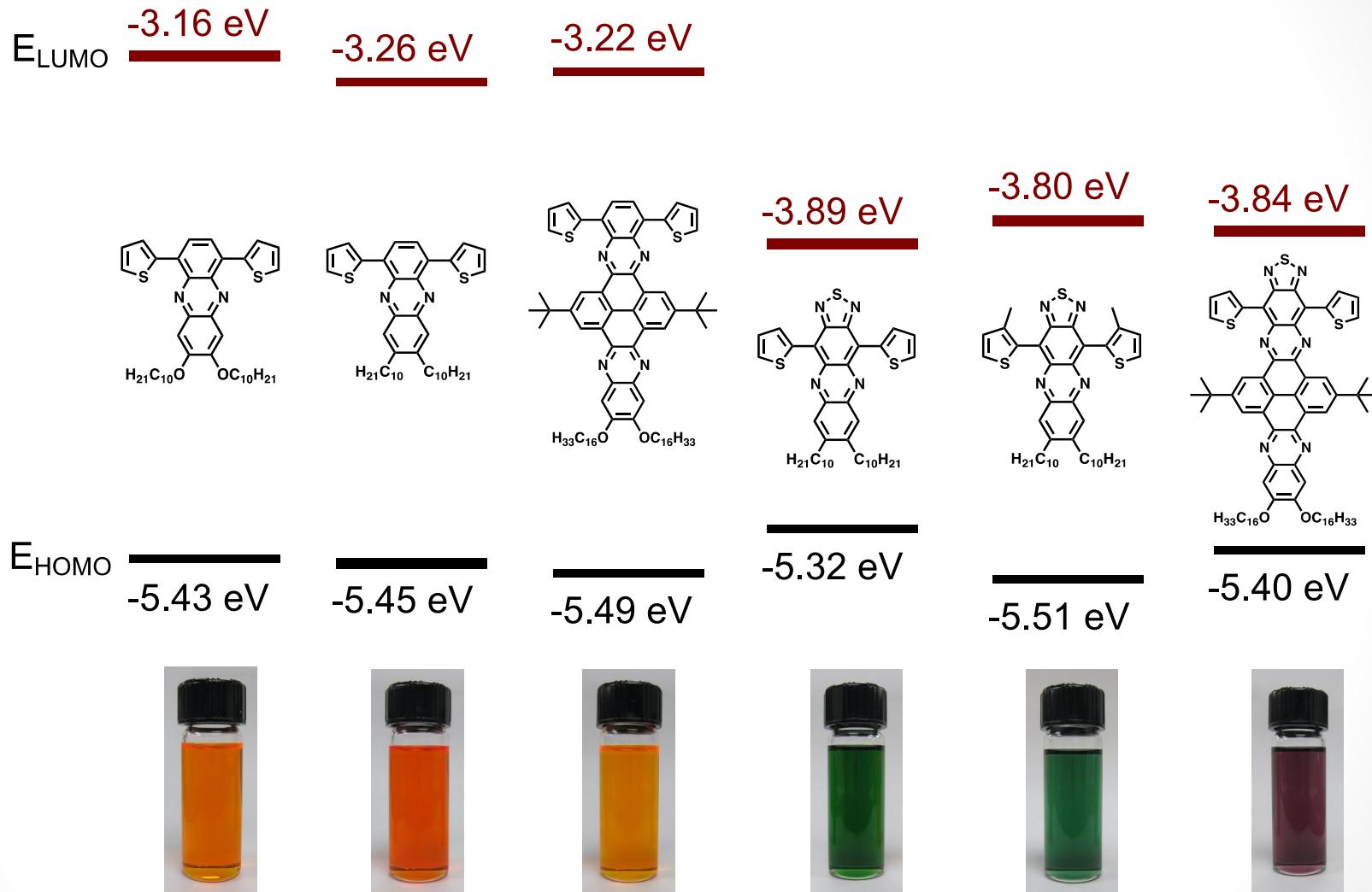
Phone: 702-895-1486

Email: [dong-chan.lee@unlv.edu](mailto:dong-chan.lee@unlv.edu)

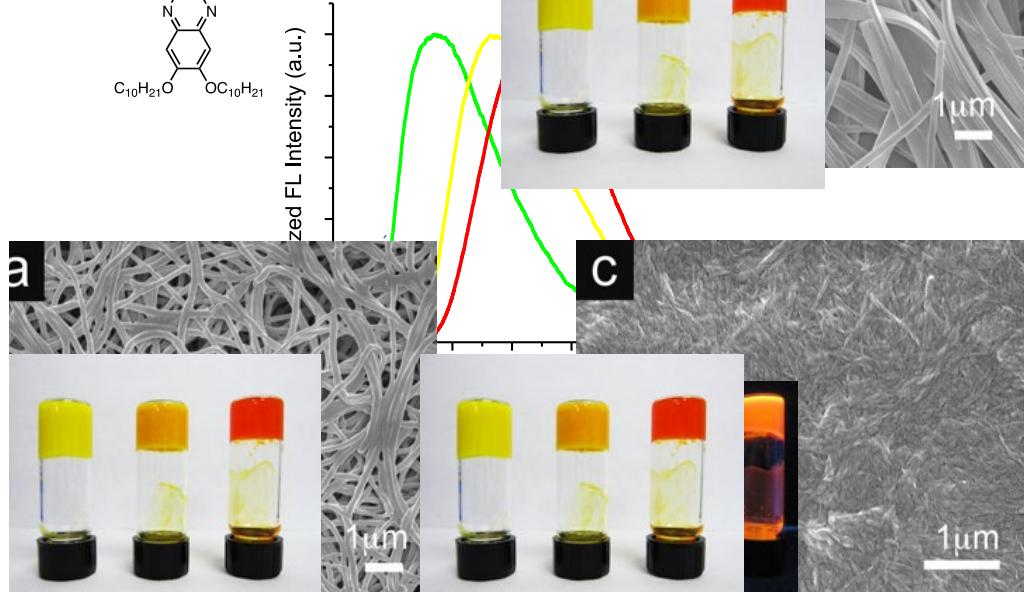
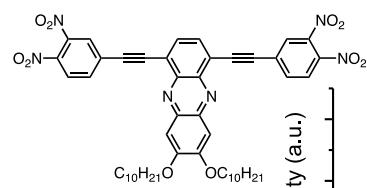
## Expertise

- Organic semiconductors with tunable electronic properties
- Self-assembly (nanomaterials, organogels, etc.)
- All organic room-temperature phosphors
- Materials development for solid-state emission with high quantum yield

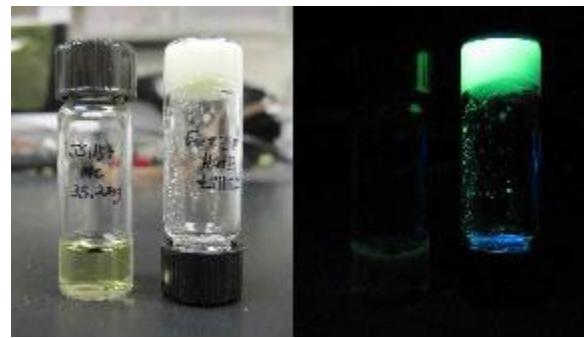
# Electronic-Property Tuning with Smart Molecular Design



# Solvent-Dependent Morphology Control through Organogelation



# Solid-State Emission with High Quantum Yield



# Gel-Induced Room Temperature Phospho- rescence

Journal of  
**Materials Chemistry**



# Quantum Information and Quantum Control of Chemical Reactions

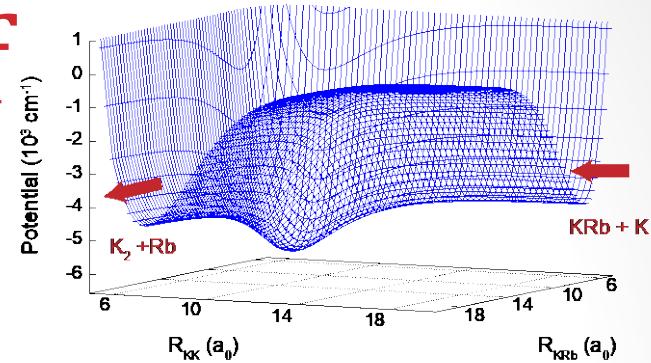
Balakrishnan Naduvalath

Department of Chemistry & Biochemistry,  
UNLV

## Areas of Expertise

- Ultracold Molecules
- Ultracold Quantum Engineered Chemistry
- Quantum control of chemical reactions
- Geometric phase effect in chemistry
- Stereodynamic control of chemical reactions

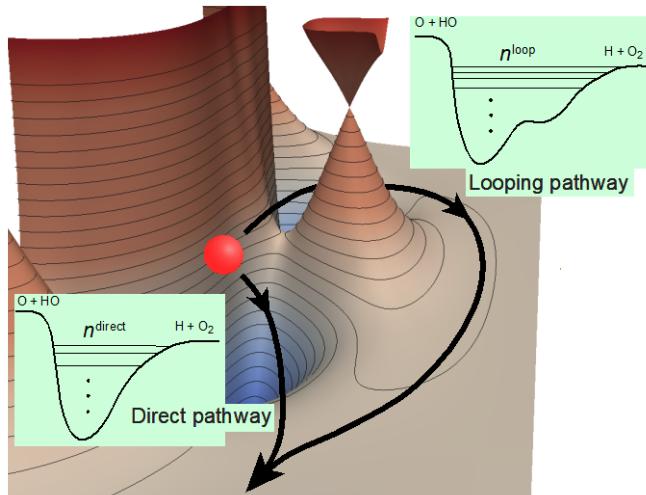
\$\$\$: NSF, DOD, NASA



Chemical reaction pathway in ultracold K+KRB collisions.

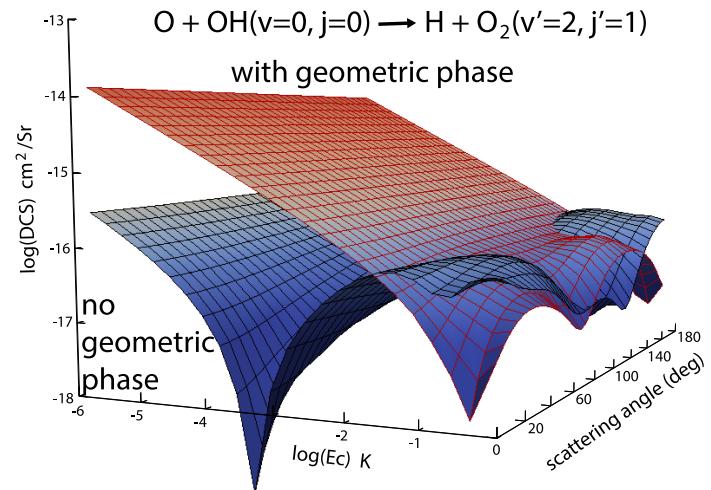
Quantum engineered KRB molecules have been prepared at 300 nK. Ultracold polar molecules such as KRB are potential candidates for quantum computing and quantum information processing.

# Controlling reaction outcome through quantum interference



Right panel: The nature of the interference can be controlled by including “geometric phase”. In the image on the right, inclusion of the geometric phase enhances the reactivity. The geometric phase (that correctly describes the sign of the wave function near a conical intersection with an excited electronic state) acts as a “quantum switch” (Hazra, Balakrishnan, and Kendrick, J. Phys. A **119**, 12291 (2015))

Left panel: Two paths for a chemical reaction. These two paths can interfere constructively or destructively, maximizing or minimizing the reaction rate. This quantum effect becomes magnified in the ultracold regime (Kendrick, Hazra, and Balakrishnan, Nature Comm. **6**, 7918 (2015)).



# References

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- J. F. E. Croft and N. Balakrishnan, Controlling rotational quenching rates in cold molecular collisions, *J. Chem. Phys.* **150**, 164302 (2019).
- K. Hilsabeck, J. Meiser, M. Sneha, N. Balakrishnan, and R. N. Zare, Photon Catalysis of Deuterium iodide photodissociation, *Phys. Chem. Chem. Phys.* **21**, 14195 (2019).
- J. F. E. Croft, N. Balakrishnan, M. Huang, and H. Guo, Unreveling the stereodynamics of cold controlled HD-H<sub>2</sub> collisions, *Phys. Rev. Lett.* **121**, 113401 (2018). (**Editor's choice**).
- J. F. E. Croft, C. Makrides, M. Li, A. Petrov, B. K. Kendrick, N. Balakrishnan, and S. Kotochigova, Universality and chaoticity in ultracold K+KRb chemical reactions, *Nature Comm.* **8**, 15897 (2017).
- N. Balakrishnan, Perspective: Ultracold molecules and the dawn of cold controlled chemistry, *J. Chem. Phys.* **145**, 150901 (2016).
- B. K. Kendrick, J. Hazra, and N. Balakrishnan, The Geometric Phase Appears in the Ultracold Hydrogen Exchange Reaction, *Phys. Rev. Lett.* **115**, 153201 (2015).
- B. K. Kendrick, J. Hazra, and N. Balakrishnan, The Geometric Phase Controls Ultracold Chemistry, *Nature Communications* **6**, 7918 (2015).

# MaryKay Orgill

**Professor**

**Department of Chemistry and Biochemistry**

- Ph.D., Chemistry, Purdue University
- Fellow, Royal Society of Chemistry
- Fellow, American Chemical Society
- Former Chair, ACS Division of Chemical Education
- Email: [MaryKay.Orgill@unlv.edu](mailto:MaryKay.Orgill@unlv.edu)
- <https://www.unlv.edu/people/marykay-orgill>



## **Areas of Expertise**

- Chemistry Education
- Biochemistry Education

## **Research Summary:**

I am interested in using qualitative research techniques to examine and improve undergraduate chemistry teaching and learning. Currently, this involves looking at how students understand concepts and solve problems in chemistry classes, how they visualize different chemical concepts, how they use language to make sense of chemical concepts, and how a systems thinking approach to chemistry teaching might be used to help students learn chemistry more meaningfully. I have also been involved in a number of projects that provide professional development opportunities to faculty and K-12 teachers.

# Postsecondary Underrepresented Minority STEM Students' Perceptions of Their Science Identity

Schetema Nealy **Charles R. Drew University of Medicine and Science**  
MaryKay Orgill **University of Nevada, Las Vegas**

JOURNAL OF  
**CHEMICAL EDUCATION**

Cite This: *J. Chem. Educ.* 2019, 96, 2720–2729

pubs.acs.



## Introduction to Systems Thinking for the Chemistry Education Community

MaryKay Orgill,<sup>\*,†</sup> Sarah York,<sup>†</sup> and Jennifer MacKellar,<sup>‡</sup>

<sup>†</sup>Department of Chemistry and Biochemistry, University of Nevada, Las Vegas, Las Vegas, Nevada 89154, United States

<sup>‡</sup>ACS Green Chemistry Institute, American Chemical Society, Washington, D.C. 20036, United States

**Multicultural  
Education**

## Supporting English Language Learners in College Science Classrooms Insights from Chemistry Students

Eshani N. Lee, MaryKay Orgill, & CarolAnne Kardash

DOI: [10.1039/C4RP00256C](https://doi.org/10.1039/C4RP00256C) (Paper) *Chem. Educ. Res. Pract.*, 2015, 16, 731-746

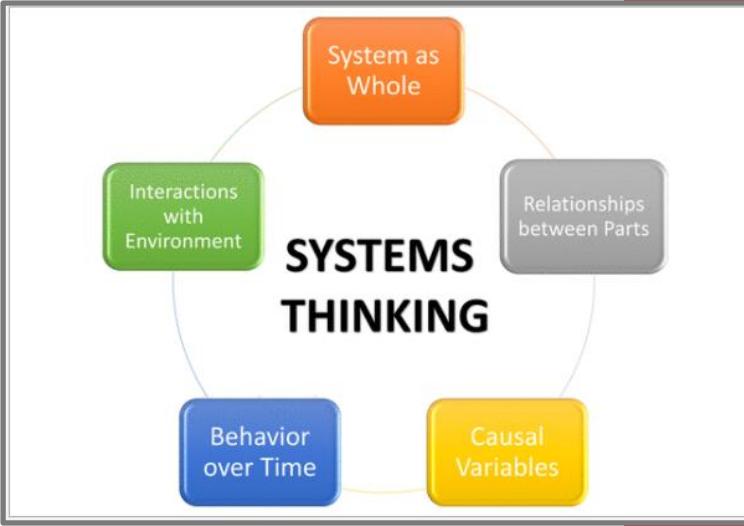
THEORETICAL  
FRAMEWORKS  
for RESEARCH in  
CHEMISTRY/SCIENCE  
EDUCATION

GEORGE M. BODNER  
MARYKAY ORGILL

## Faculty Perceptions of the Factors Influencing Success in STEM fields

Eshani Gandhi-Lee<sup>1</sup>, Heather Skaza, Erica Marti, PG Schrader, MaryKay Orgill

*University of Nevada, Las Vegas, USA*



## Biochemistry instructors' perceptions of analogies and their classroom use

MaryKay Orgill <sup>\*,a</sup>, Thomas J. Bussey <sup>b</sup> and George M. Bodner <sup>c</sup>

<sup>a</sup>Department of Chemistry and Biochemistry, University of Nevada, Las Vegas, USA. E-mail: [marykay.orgill@unlv.edu](mailto:marykay.orgill@unlv.edu)

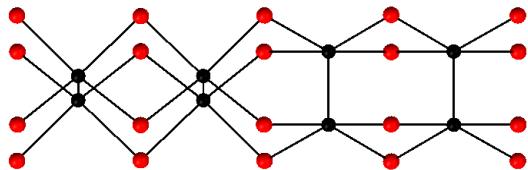
<sup>b</sup>Department of Chemistry and Biochemistry, University of California, San Diego, USA

<sup>c</sup>Department of Chemistry, Purdue University, USA

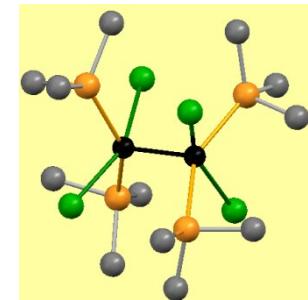
→ Synthetic and coordination chemistry

Technetium binary and ternary halide compounds

Compounds with multiple metal-metal bonds



TcCl<sub>2</sub> : a unique structure-type



Tc<sub>2</sub>Cl<sub>4</sub>(PMe<sub>3</sub>)<sub>4</sub>

→ Chemistry relevant to remediation and fuel cycle applications

Separation, vitrification, and waste forms (alloys)



Demonstration of the separation of  
uranium from technetium for fuel cycle application



Preparation of U-Tc alloys by arc melting

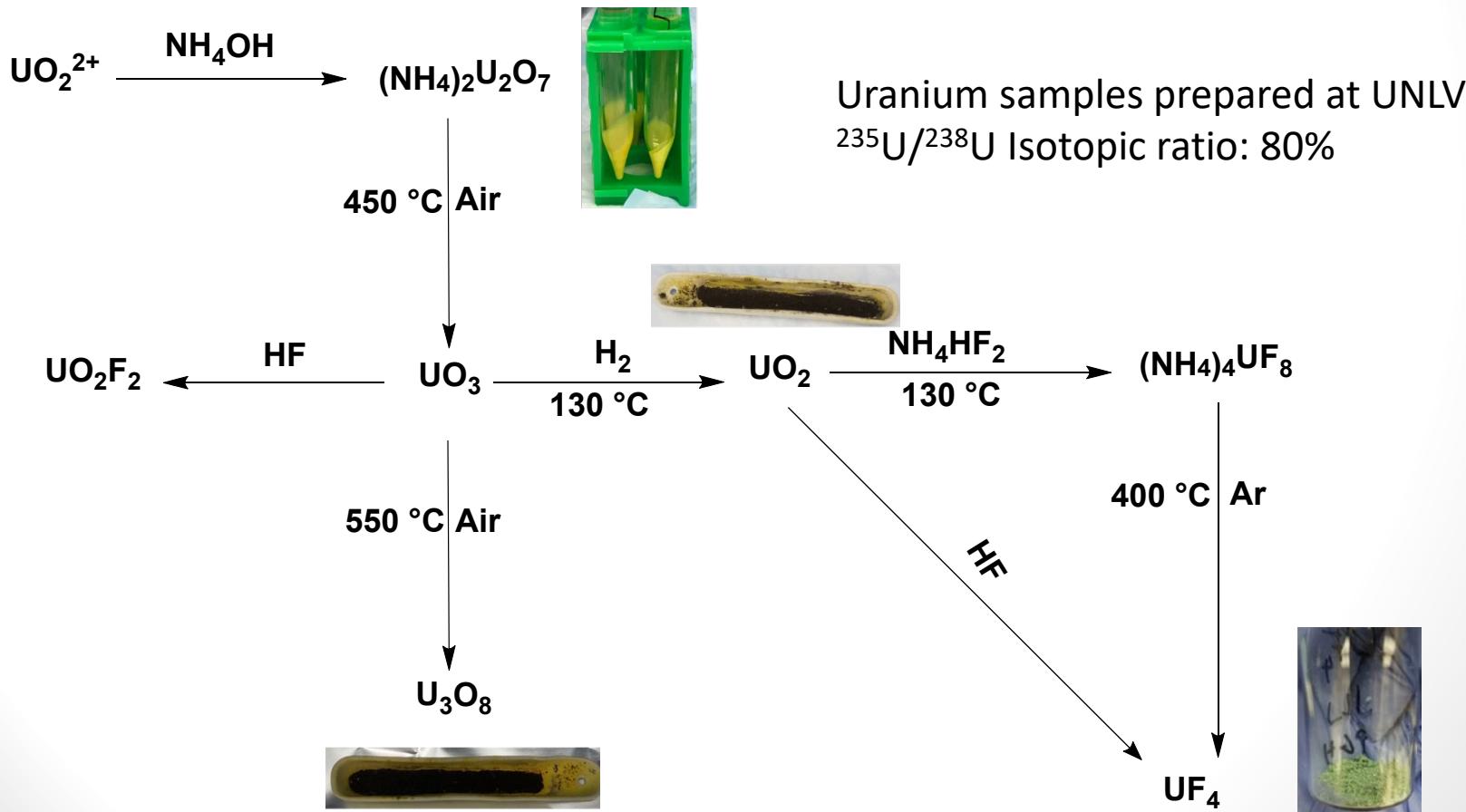
# Technetium and Uranium Chemistry

Frederic Poineau, PhD  
Radiochemistry

→ Collaborative work relevant to nuclear forensics

Analysis of Uranium Isotopic Ratios by Thermal Ionization Mass Spectrometry (TIMS)

- Uranium compounds found throughout the fuel cycle ( $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$ ,  $\text{UF}_4$ ) prepared at UNLV
- $^{235}\text{U}/^{238}\text{U}$  isotopic ratio measurements using TIMS at LANL



# Colloidal Quantum Dots: Single-Photon Emitters & Sensor Materials

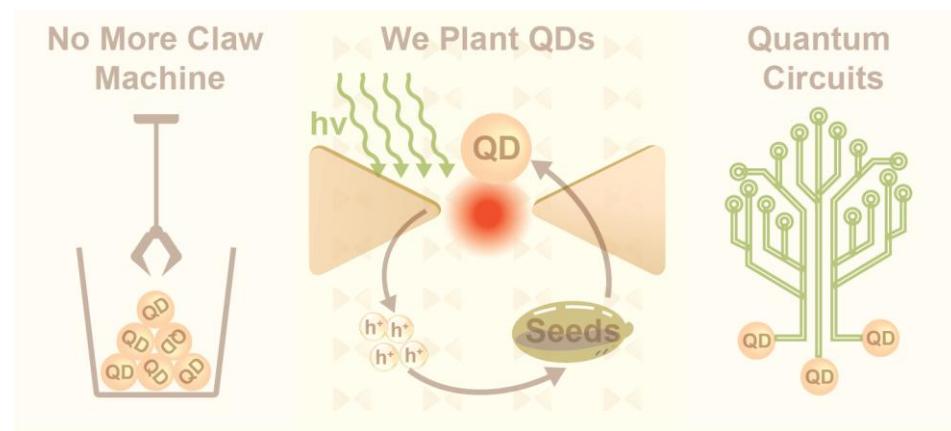
- **Dr. Tian Qiao**
- Assistant Professor
- Department of Chemistry and Biochemistry
- Email: [tian.qiao@unlv.edu](mailto:tian.qiao@unlv.edu)
- Website: [gtlab.sites.unlv.edu/](http://gtlab.sites.unlv.edu/)

## Expertise

- Synthesis of Colloidal Quantum Dots
- Optical Spectroscopy
- Single Photon Emitters
- Shortwave IR Emitters

On-demand synthesis of colloidal quantum dots

SWIR colloidal quantum dots for LIDAR



# Measuring student motivation in chemistry classrooms

- **Dr. Guizella A. Rocabado**
- Assistant Professor of Chemistry
- Department of Chemistry and Biochemistry
- Email: [guizella.rocabado@unlv.edu](mailto:guizella.rocabado@unlv.edu)



## Expertise

My expertise lies in chemistry education research, with a particular focus on the development of instruments and the application of advanced measurement and statistical techniques to evaluate the effectiveness of evidence-based instructional practices. A central passion and area of expertise is understanding and measuring student attitudes and motivation, particularly as they relate to engagement and success in chemistry learning environments. I specialize in designing tools that capture meaningful learning outcomes, affective dimensions, and instructional impacts. In addition to my methodological strengths, I bring experience in science communication, translating complex scientific ideas into accessible language for diverse audiences. I also have expertise in program evaluation, using data-driven approaches to assess and improve the design, implementation, and outcomes of educational initiatives in STEM fields.

# Biochemistry – Interrogate Cell Signaling Pathways by Molecular, Genetic and Proteomic Approaches

**Dr. Hong Sun**

Associate Professor

Department of Chemistry and Biochemistry

Telephone: (702) 774-1485

Email: [hong.sun@unlv.edu](mailto:hong.sun@unlv.edu)

## **Expertise**

Cell signaling

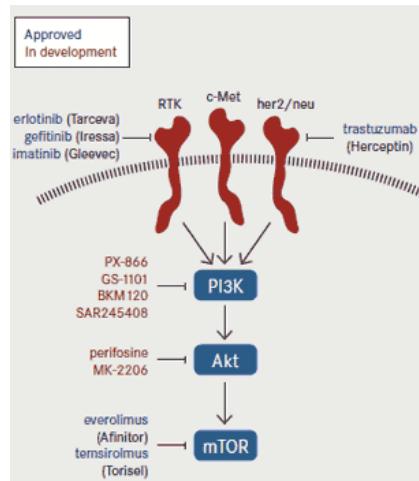
Cancer cell biology

Stem cell biology

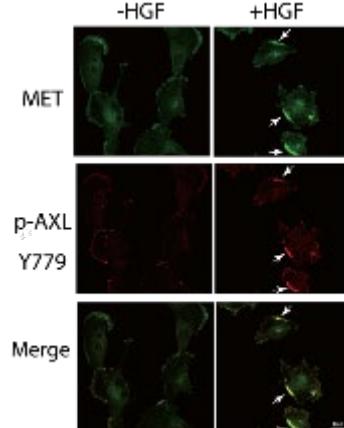
Mouse conditional knockout models

# Regulation of cell surface receptor RTKs localization and activation

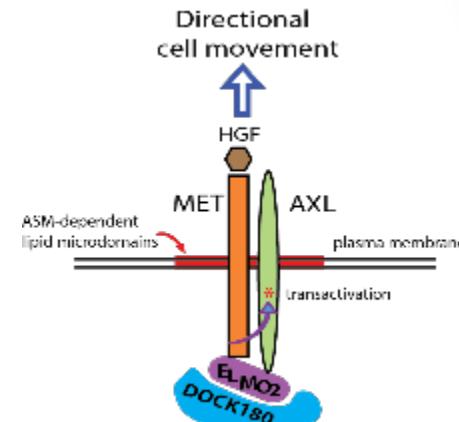
Problem: cancer cells often have multiple receptors (RTKs) activated on cell surface, making targeting inefficient



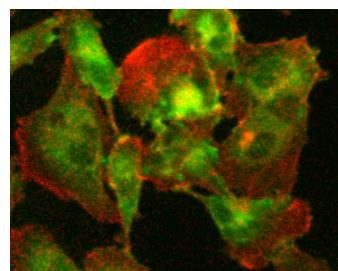
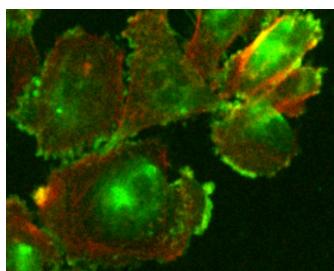
**Co-activation of AXL-MET RTKs:**  
HGF (ligand for MET) also activates AXL, detected by antibodies for p-AXL-Y779



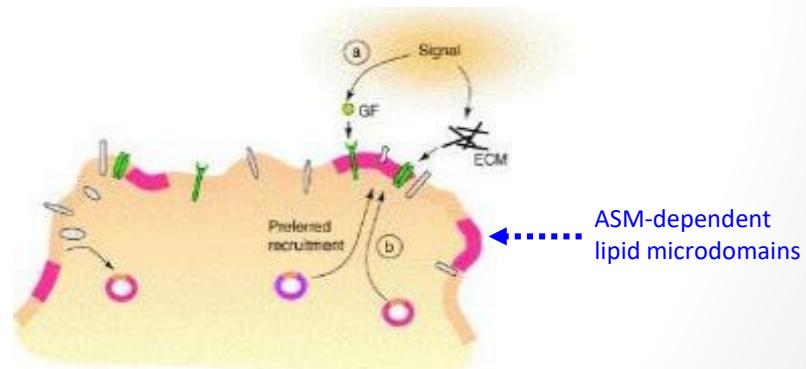
**A novel mechanism discovered for RTK-Co-activation and signaling for cancer cell migration and invasion**



Li et al., J. Biol. Chem. (2018) 293:15397-15418.



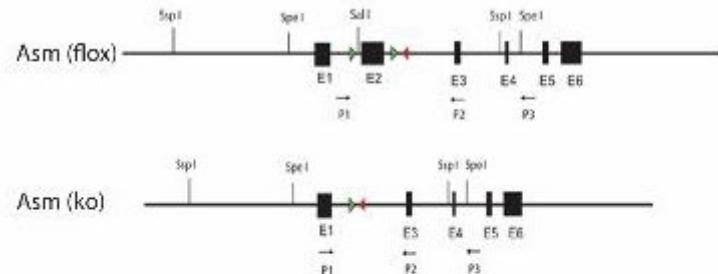
ASM inhibition prevents the MET RTK to be transported to the cell surface, as revealed by immunostaining (MET, green label; and a control cell surface protein, red label).  
Zhu et al, J. Cell Science (2016) 129, 4238-4251.



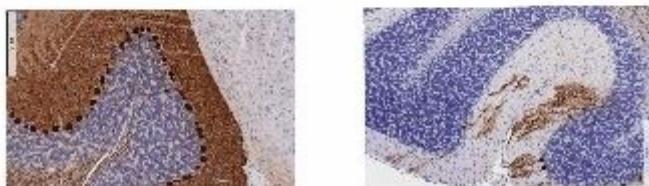
Mass-Spectrometry analyses revealed that the ASM-regulated local lipid microdomains were enriched with many signaling molecules.  
Xiong et al. Biol. Open (2019) 8, bio040311.

# Regulation of stem cell maintenance: insights from the genetic studies in novel mouse knockout models

## A. Gene locus

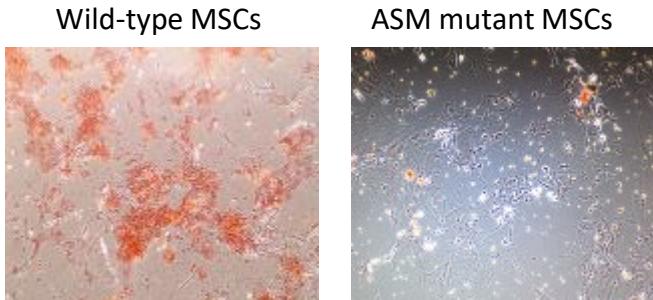


## B. Loss of Purkinje neurons in cerebellum



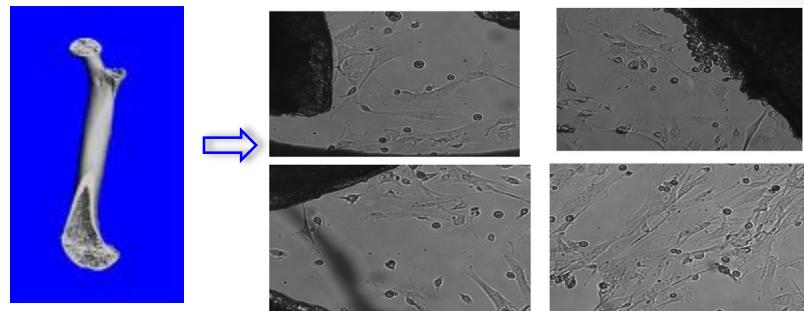
Purkinje neurons immunostained with D28K antibody.

## D. ASM mutant MSCs failed to become bone-forming cells



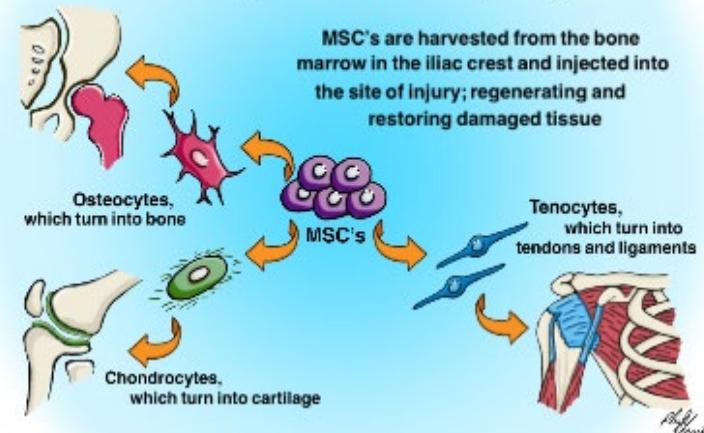
(*in vitro* differentiation assay, then stained with alizarin red)

## C. Mesenchymal stem cells (MSCs) cultured from bones



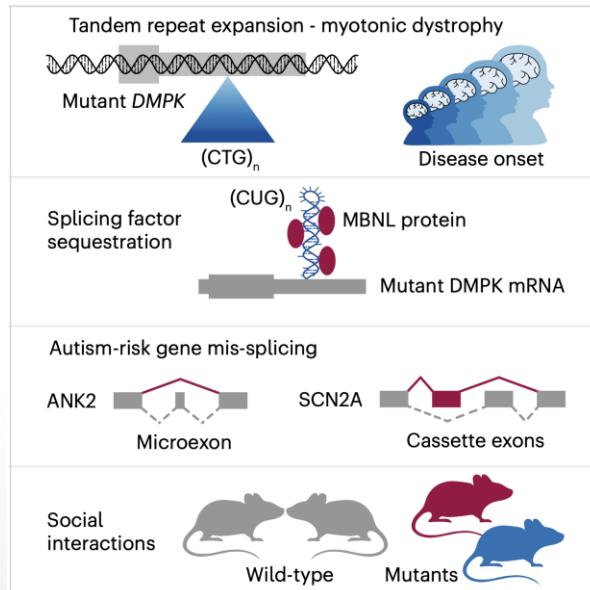
## E. Potentials of MSCs for tissue repair

**Mesenchymal Stem Cells, or MSC's**  
have the ability to differentiate into any cell type



# Neurogenetics

- **Dr. Łukasz J Sznajder**
- Assistant Professor
- Department of Chemistry and Biochemistry
- Email: lukasz.sznajder@unlv.edu



## Expertise

- Neurodevelopmental and neuromuscular disorders
- Genetics, RNA biology, and bioinformatics
- Disease mechanisms and gene therapy

# Stem Cells, Genetic and Epigenetic Inheritance, Cancer

## Dr. Hui Zhang

Associate Professor

Department of Chemistry and Biochemistry

Phone: (702)774-1489

Email: [hui.zhang@unlv.edu](mailto:hui.zhang@unlv.edu)

### Expertise:

- Biochemistry and developmental regulation of pluripotent embryonic stem cells, adult stem cells, and related diseases
- Regulation of chromatin structure, epigenetics, and transcription by protein methylation and ubiquitin enzymes
- DNA replication, DNA repair, cell cycle, genome instability, and cancer
- Targeting the vulnerability of human cancers

# Current research areas in Zhang Laboratory:

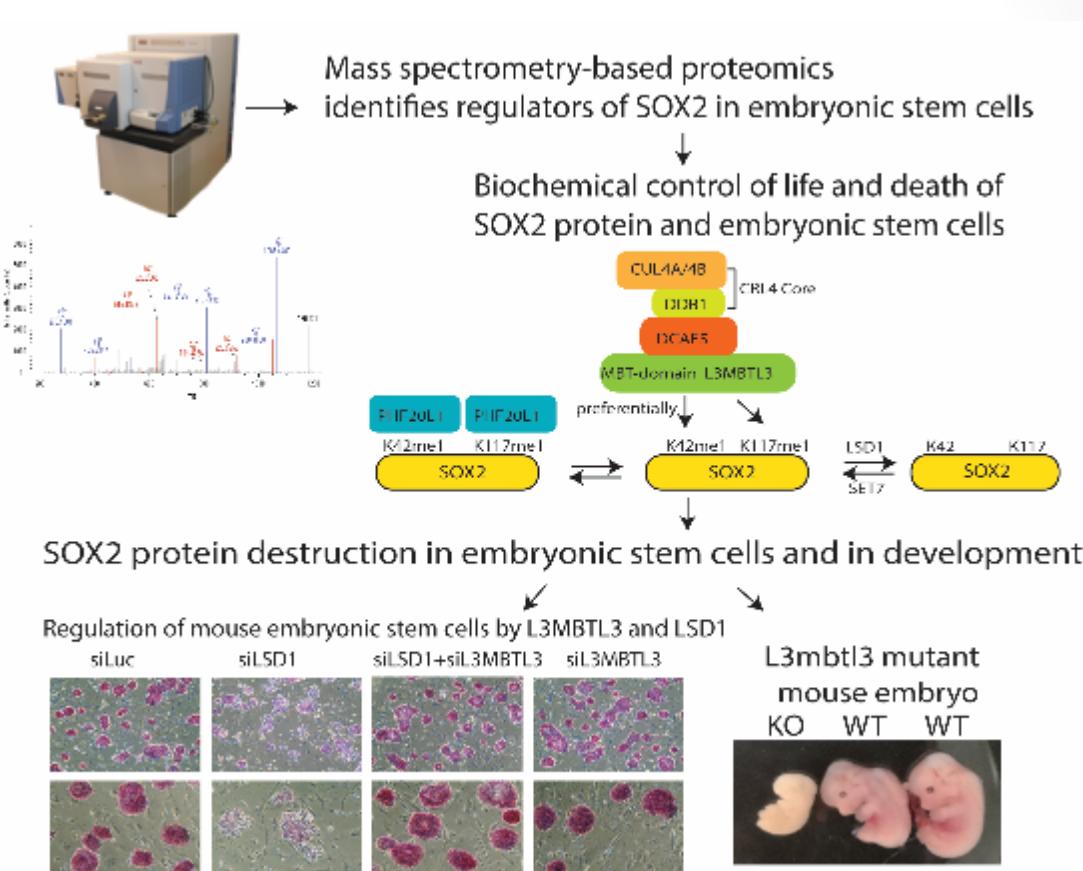
- Discover novel proteins essential for stem cell regulation, examples:

**How SOX2 is regulated in embryonic stem cells and many other stem cells in development?**

- Sox2 is a master stem cell protein that controls the self-renewal and pluripotency of embryonic stem cells that can develop into any tissue types of cells in development.

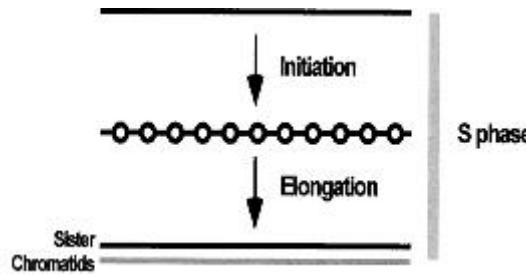
- SOX2 is also a master regulator of many adult stem cells including the stem/progenitor cells for brain, lung, colon, breast, liver, cochlea/ear, skin, retina, ovary, bladder, esophagus, and testes for tissue repair/regeneration.

- Artificial Sox2 expression (together with Oct4 and accessory Klf4, and Myc) can virtually convert any differentiated cells, such as skin or blood cells, into induced pluripotent stem cells (iPSCs), the embryonic stem cell-like cells.

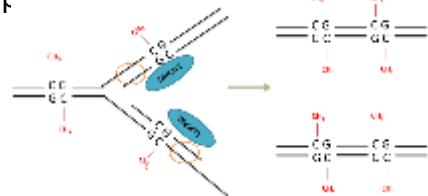


- Discover novel proteins important for epigenetic and cell cycle regulation, examples:
- Regulation of DNA replication and DNA methylation in normal and cancer cells

- How DNA replicates only once in one cell cycle in animal cells? How re-replication is prevented that causes genome instability and c

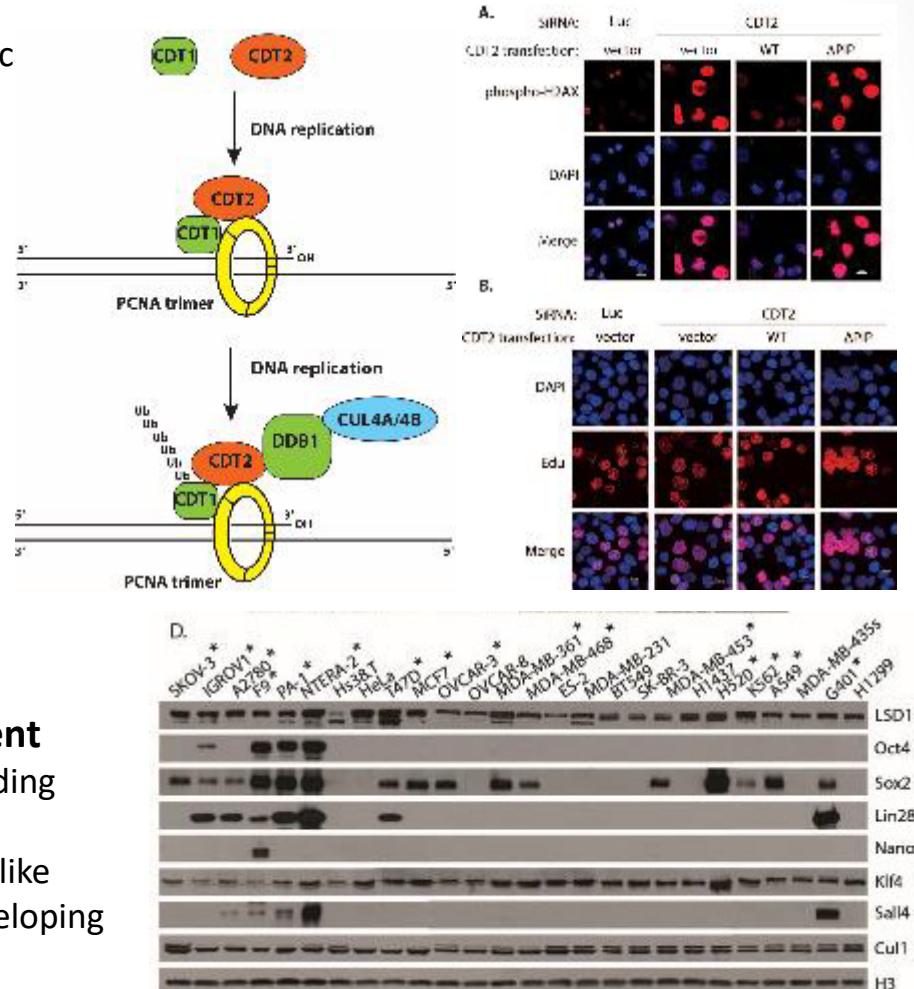


- How the fidelity of epigenetic DNA methylation is maintained during DNA rep



- **Cancer Biology and therapy development**

Elevated SOX2 levels cause many cancers including cancers of lung, brain, breast, and ovary. These cancers are hard to treat because they behave like stem cells due to SOX2 expression. We are developing novel LSD1 chemical inhibitors that target the epigenetic vulnerability of these cancer cells.



The presence of SOX2 in different types of cancer cells is responsible for sensitivity towards our LSD1 inhibitors. \*: Sensitive to LSD1 Inhibitors