UNIVERSITY OF LOUISVILLE

COLLEGE OF ARTS & SCIENCES

Department of Chemistry

Brown and Williamson Series

Friday, November 19
@4:00 pm
CB LL16

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Thermally and Photothermally Activated Diradicals: From Small Molecule Bioreagents To New Nanomedicine Applications and Nanocatalysis of CO_2

ABSTRACT:

Our research interests lie in developing thermal and photochemical-Bergman cyclization reactivity in inorganic small molecules, porphyrins, and nanoparticle surfaces for carbon-based polymerization reactions, or as nature has taught us, biologically-relevant H-atom abstraction reactivity. While a considerable amount of our efforts are devoted to developing fundamental metal-catalyzed cyclization reactions, we have also applied these motifs to a subset of natural biopolymers such as plaques and fibrin clots.

Disease states resulting from metal-mediated biopolymer deposition can arise when the natural cleavage mechanisms become inoperative or function poorly, such as the formation of amyloid plaques which have been connected to the neurodegenerative disease Alzheimer's, as well as thrombotic disease (atherosclerosis) leading to heart attack or stroke. Current treatment options for amyloid plaque buildup involve inhibition or activation of specific enzymes involved in the disease pathway, while acute arterial thrombosis is combated via the use of anti-platelet agents or anti-coagulants that inhibit the thrombus. In the latter case, side effects associated with such anti-coagulants involve the risk of systemic bleeding which can supersede the benefit of the antithrombotic therapy.

Our approach to these problems involves developing small molecule enediyne ligands that extract metal directly from the plaque (Cu, Zn, of Ca), or incorporation of diradicals-generating ligands into optically-active Au and magnetically responsive Fe_3O_4 nanoarchitectures. Small molecules with N_4-coordination have been developed for disaggregation of amyloid plaques by *in situ* activation and radical-formation upon chelation of Zn(II) and Cu(II), while larger-payload nanoparticles that can be activated photo-thermally or by magnetic induction hyperthermia are applied to dissolve fibrin clots. This presentation will describe several chemical and applied aspects of this work including novel nanocatalysts for CO_2 activation derived from these frameworks.

BIO:

Jeff Zaleski received his B.S. degree from SUNY at Geneseo in 1988 followed by his Ph.D. from Michigan State University in 1993. Following, he was awarded the Jane Coffin Childs Postdoctoral Fellowship at Stanford University where he studied Physical-Biorganic chemistry under the direction of Professor Edward I. Solomon. Jeff Zaleski joined the faculty at Indiana University in 1996. He was promoted to Professor in 2004, named Associate Vice Provost for Research in 2015, and has been Vice Provost and Associate Vice President for Research since 2019. His research interests are in the fields of metals in medicine, bioinorganic chemistry, synthetic chemistry, and materials.