**University of Maine  
Department of Chemistry  
Seminar Presentation**

**Tuesday, April 8, 2025  
Aubert Hall 316  
11:00 AM**

**Mysteries in the Framework: Unexpected Behavior of Ni²⁺ and Mn²⁺ in Ionothermal Aluminophosphate Synthesis  
Dr. Susan Citrak**

**Abstract:**

Aluminophosphates (AlPO₄s) are porous materials structurally analogous to zeolites, in which the typical silicon and oxygen tetrahedral framework is replaced by alternating Al³⁺ and P⁵⁺ centers bridged by oxygen atoms. This results in a neutral framework that can be tuned for catalytic applications through aliovalent metal substitution, replacing Al³⁺ with divalent metals (M²⁺) or P⁵⁺ with tetravalent metals (M⁴⁺), to generate Brønsted acid sites.

Ionic liquids (ILs) have gained significant attention over the past three decades due to their low vapor pressure, low toxicity, and versatility as reaction media. In “ionothermal” aluminophosphate synthesis, ILs serve not only as solvents but also as structure-directing agents, enabling the formation of novel framework phases that are often inaccessible through conventional hydrothermal methods.

This presentation highlights recent findings from our group on the ionothermal synthesis of aluminophosphates, with a focus on incorporating Ni²⁺ and Mn²⁺ into the AFI framework - an AlPO₄ topology known for its resistance to certain aliovalent substitutions, particularly with Ni²⁺. Interestingly, while actual metal incorporation was minimal or absent, both Ni²⁺ and Mn²⁺ exhibited strong, yet opposite, structure-directing effects. This unexpected and puzzling behavior has launched our group into deeper investigation. Additional studies explored the effects of adding water and hydrofluoric acid to this non-aqueous system, revealing further complexity in phase formation and crystallinity, and raising even more questions.

Together, these results not only underscore the intricate chemistry of metal substitution in AlPOs but also open the door to new mysteries in ionothermal synthesis where the unexpected is often just the beginning.

**Bio:**

Dr. Susan Citrak is an inorganic materials chemist with a rich background in both research and teaching. She earned her Ph.D. in Inorganic Materials Chemistry from the University of California, Santa Cruz, following a B.Sc. in Chemistry from Mills College in Oakland, California. Her early research at Mills focused on physical organic chemistry, specifically investigating unimolecular solvolysis reactions involving carbocationic intermediates in ionic liquid solvent systems. During her doctoral studies, she shifted her focus to inorganic materials chemistry, exploring the structure, stability, and anion exchange properties of metal-organic coordination polymers, as well as the ionothermal synthesis of metal-substituted aluminophosphate molecular sieves with potential applications in catalysis.

In the Fall of 2024, Dr. Citrak joined the faculty at Youngstown State University, bringing over a decade of experience teaching both lower and upper-division chemistry courses. Recently, her research interests have expanded to include a new class of materials called porous liquids, which intriguingly combines her previous work with ionic liquids and solid-state materials into a single, exciting area of study.

Beyond her research, Dr. Citrak is deeply committed to pedagogical advancements, particularly in teaching challenging subjects to first-generation and underserved students. She is passionate about making complex chemistry accessible and engaging for all her students.

Outside of academia, Dr. Citrak holds a purple belt in Brazilian Jiu-Jitsu and enjoys spending her free time gardening, fishing, and playing video games with her family. She is excited to call Youngstown, Ohio, her new home.

