MISSOURI S&T Chemistry Seminar

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Monday, 10 November, 2025

4:00 pm in 126 Schrenk Hall

Development of Phosphinate-Containing Polymers for Conformance Control in Geothermal Reservoirs

Bio: Sara McCauley is a fourth-year graduate student in the Chemistry Department at Missouri S&T, working in the Schuman group to develop hydrogel materials. Sara is a Kummer Innovation and Entrepreneurship Doctoral Fellow. She completed her Bachelor's of Science with an emphasis in Polymers and Coatings from Missouri S&T in 2022.

Abstract: As atmospheric carbon dioxide levels continue to rise, geothermal energy has emerged as a promising energy alternative to fossil fuels. Enhanced Geothermal Systems (EGS) have the potential to supply vast amounts of energy but suffer from key challenges that limit their wide-scale implementation. Macro-level heterogeneity in the rock matrix such as cracks, void spaces, and flow conduits divert fluid flow away from unswept portions of the geothermal reservoir and can cause thermal drawdown and cooling of the reservoir. In the context of oil reservoirs, the same problem has been successfully addressed by injecting hydrogel particles that travel preferentially to ultra-high permeability zones and selectively block fluid flow in these regions. Gel injection is a mature technology in the petroleum field but is yet to be widely applied in geothermal reservoirs due to the harsh thermal conditions that hydrogels must withstand. We aim to develop a polymer hydrogel material that withstands hydrothermal conditions of 275°C for three months and remains swollen during that time. To this end, we have developed phosphinate analogs of poly(sodium styrene sulfonate) (pNaSS) with the hypothesis that the phosphinate group will have higher hydrothermal stability than the sulfonate group. We will present the synthesis and characterization of a phosphinate-modified polystyrene and the results of hydrothermal testing. Degradation mechanisms will be explored in analogy to the degradation of sulfonate-containing polymers and implications for further research will be discussed.