

# Upcycling of Nitrate: An example of waste-to-value engineering

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**Abstract:**

Over 10 million tons of nitrogen, contained in a variety of fertilizers, are applied to U.S. crop lands every year to secure the yield and quality of food and fiber productions. However, approximately half of nitrogen is not taken and utilized by plants, and the lost nitrogen, as agricultural run-off, ends up in the form of nitrate that is a notorious and hazardous pollutant. On top of agricultural fertilization, meat- processing facilities, municipal wastewater discharges, and other sources also contribute to the national nitrate pollution. High nitrate concentration in waterbodies threatens the public health in nearby areas, and excessive nitrate in major rivers has been linked to a series of ecological disasters such as eutrophication, hypoxia, and harmful algal blooms. The mitigation of nitrate pollutions is widely recognized as a techno-economic-environmental complex, which poses a pressing challenge yet an unprecedented opportunity for research and business. Capture, concentrating, and conversion of nitrate from agricultural wastewaters and other nitrate-containing streams could formulate a viable solution. In this seminar, Dr. Gu will share some of research progress and learned lessons revolving around the upcycling of waste nitrate as an example of waste-to-value engineering. The discussion will focus on the following topics: 1) nitrate capture by designing and developing a new family of highly nitrate-selective polymers, 2) nitrate concentrating by understanding and advancing low-concentration electro dialysis, 3) nitrate conversions by exploring and enhancing selective electrosynthesis of both ammonia and nitrite from waste nitrate, and 4) nitrate/ammonia-assisted CO<sub>2</sub> capture to manufacture green formate and urea.

**Biography:**

Dr. Shuang Gu is an Associate Professor of the Department of Mechanical Engineering at Wichita State University (WSU). He received Ph.D. training from both University of California – Riverside (UCR) and Dalian University of Technology (DUT), and he earned his Ph.D. degree in Chemical Engineering in 2008 from DUT. Then he worked as a Postdoctoral Researcher first in UCR (2008–2011) and then in University of Delaware (UD, 2011–2012). After postdoctoral training, he worked as a Research Assistant Professor in the Department of Chemical and Biomolecular Engineering at UD from 2012 to 2015. He joined WSU in fall 2015 as an Assistant Professor and received early tenure and promotion in 2020 to his current rank.

**\*This seminar counts towards the ME 600 seminar requirement  
for Mechanical Engineering graduate students.**

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