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Self-Healing and Electrochemical Fouling Control: Navigating Tradeoffs in Environmental Applications

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ABSTRACT: Self-healing materials can recover from physical and chemical damage autonomously or with the input of a simple stimulus. Similarly, self-cleaning materials can remove attached foulants with the application of a simple stimulus. Such "smart materials" are envisioned to improve safety, reduce process downtime, and extend the lifetime of materials and processes that depend on these materials. This presentation will discuss the design of these two categories of materials, focusing on their application in environmental engineering.

Self-healing materials rely on one of two approaches: 1) embedding an encapsulated reactive healing agent that is exposed when the material is damaged and 2) using materials with reversible bonding that reform easily after breaking. The talk will discuss how healing agent chemistry and reaction kinetics impact release of unwanted constituents into the environment and the impact of different ions in water on self-healing based on secondary bonds. In situ fouling cleaning can be achieved using electrically conductive surfaces and electrochemical reactions that occur on these surfaces. Specific mechanisms include dispersal of attached biofilm via gas evolution reactions and generation of reactive species to inactivate bacteria and degrade organic foulants. This talk will discuss the performance of a novel design for electrically conductive membranes where an interdigitated pattern of carbon nanotubes is deposited on the membrane surface.

Seminar Details

Friday, April 4, 2025
2:30pm – 4:00pm

UH Campus Classroom & Business Building Room CBB 108

Online via TEAMS
https://www.cive.uh.edu/research/seminars

BIOGRAPHY: Dr. Getachew is an Assistant Professor in Environmental Engineering at Rice University. Her research focuses on designing responsive membranes and materials for water treatment and providing mechanistic understanding of their performance. She is a recipient of the ACS PRF New Investigator Award and her work has been funded by NSF and DOE. Dr. Getachew completed her Ph.D. and M.Sc. in Chemical and Environmental Engineering at Yale University, where she developed the first autonomously self-healing water filtration membranes. She also holds a B.S. in Chemical Engineering (ABET) from Yale. Prior to joining Rice University, Dr. Getachew spent two years as a Postdoctoral Associate at the Department of Materials Science and Engineering at Massachusetts Institute of Technology. Current projects in her group at Rice include studying self-healing polymeric materials under exposure to complex water matrices, determining the transport properties of organic-inorganic hybrid membranes, electrically conductive membranes for fouling and scaling mitigation, and the stability of hydrogel encapsulants for microbes used in wastewater treatment