Development of Anti-Fouling, Anti-Microbial Membranes for Wastewater Treatment

Steven Weinman[a], Maria Bass[b], Viatcheslav Freger[b], Moshe Herzberg[c], Scott Husson[a]

[a]Department of Chemical & Biomolecular Engineering, Clemson University, Clemson, SC 29634
[b]Wolfson Department of Chemical Engineering, Technion - Israel Institute of Technology, Haifa, 32000 Israel
[c]Zuckerberg Institute for Water Research, Ben Gurion University of the Negev, Sede-Boqer Campus, Midreshet Ben Gurion, 84990 Israel

Treatment of impaired waters for beneficial use exposes the membranes to feed waters containing biological and abiotic species, which leads to fouling and loss of membrane productivity over time. Since reduction in flux due to fouling is one of the largest costs associated with membrane processes in water treatment, new coatings that limit and reverse fouling would have significant economic and societal impacts**.** Developing these advanced coatings is the focus of our work.

Prior studies to control biofouling largely have focused either on preventing microorganisms from attaching or killing the microorganisms once they do attach. Based on considerable literature and experience, we know that each of these control strategies alone can be effective but not sufficient for controlling biofouling. Our hypothesis is that membranes coated with dual-mode polymer nanolayers can limit and reverse membrane biofouling by switching reversibly between passive (antifouling) and active (antimicrobial) states of biofouling control. This strategy differs fundamentally from most other surface modification strategies that rely solely on passive control (i.e., using coatings designed only to weaken foulant adhesion and, thus, limit their accumulation) or active control (e.g., adding biocides).

In this poster, we will introduce the methodologies used to coat surfaces with carboxybetaine zwitterion dual-mode polymer nanolayers designed to combat biofouling. We will explain the chemical switching mechanism and use FTIR and streaming potential measurements to support the reversible switching of the polymer nanolayer between its antifouling and antimicrobial states. Subsequently, the feasibility of the approach will be tested in bacterial deposition and membrane biofouling experiments using appropriate model systems. Initial bacterial deposition results show a similarly low bacteria initial attachment rate as compared to other common zwitterion coatings.