Northeastern University
College of Engineering

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Distinguished Seminar Speaker

Come to my window: Porosity & binding distribution provide better predictors for biofilm penetration

Prof. Andrew D. Jones

Assistant Prof. of Civil & Environmental Engineering | Duke University | Durham, NC

Abstract: The Jones Systems for Engaging the Environment Lab builds novel tools to study biofilm dynamics. In this presentation we will discuss two such tools: a mechanical tool and a mathematical tool describing Pseudomonas aeruginosa PAO1 interaction with antibiotics. Biofilms are the common mode of life for bacteria in infections and in the environment. Biofilm infections have been shown to be more recalcitrant to antibiotic treatment than planktonic bacteria. This recalcitrance has been partially attributed to periphery sequestration, where antibiotics fail to penetrate biofilm cell clusters. Biofilms have also been identified as the primary environmental sink of engineered nanomaterials. However, there have been results attributing charge as the main predictor of biofilm uptake of these nano-sized materials. We developed a model for antibiotic accumulation in bacterial biofilm microcolonies using heterogenous porosity and attachment site profiles replicating the periphery sequestration reported in prior experimental studies on Pseudomonas aeruginosa PAO1 biofilm cell clusters. We account for periphery sequestration using two physical phenomena: biofilm matrix attachment and volume-exclusion due to variable biofilm porosity. The antibiotic accumulation model which incorporated both phenomena better fit observed periphery sequestration data compared to previous models that leveraged charge. We propose a novel tool for being able to conduct medium throughput screens with microscopy measurements on these biofilms and validate it against existing standards. We show quantifiable effects of antibiotics on biofilm streamers and propose that this may be useful for quantifying the attachment site density and porosity.

Biography: Akhenaton-Andrew (Andrew) D. Jones, III is an Assistant Professor of Environmental Engineering and affiliate faculty in the Mechanical Engineering & Materials Science Department, Duke Materials Initiative, and Integrated Toxicology & Environmental Health Program at Duke University. His research uses engineering and policy analysis to help solve global challenges related to water and health. He is a 2021 recipient of the NIH R35 Maximizing Investigator's Research Award to develop new models and tools for studying biofilms and a 2019 Sloan SEED fund award to develop new tools for point of use water quality monitoring systems. He was recognized as Young Investigator by the Center for Biofilm Engineering at Montana State, the premier center for biofilm research in the US. He received a BS in Mathematics and BS, MS, and PhD in Mechanical Engineering from MIT where he was a Lemelson Presidential Fellow and Alfred P. Sloan UCEM Scholar. He completed post-doctoral training as a Future Faculty Fellow at Northeastern University. He has directly supervised 2 high school students, over 20 undergraduates, 5 MS, 6 PhD, and 2 post-doctoral trainees including 12 from underrepresented backgrounds and 24 women. He and his team have presented at over 50 conferences and seminars. He is the 2023 Recipient of the Duke Outstanding Postdoctoral Mentor Award.