Controlling Microbial Dynamics Using Substrate Conductive Biointerfaces and Nanomaterials.

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Bio: Dr. Niepa is an assistant professor of Chemical and Petroleum Engineering at the Swanson School of Engineering at the University of Pittsburgh. He held a Postdoctoral Fellowship for Academic Diversity at the University of Pennsylvania (Chemical and Biomolecular Engineering), working with Professors Kathleen Stebe, Daeyeon Lee and Mark Goulian (Biology) to develop new methods to study microbial dynamics in artificial microniches and thin films. Dr. Niepa started his academic journey in the Ivory Coast, where he received his Associate Degree in Food Science and work experience at the Pasteur Institute. He then moved to Germany to study Bioengineering at the University of Dortmund and transferred to Syracuse University. He received his B. Sc. in Bioengineering (2009) and Ph.D. in Chemical Engineering (2014) with honors from Syracuse University. His doctoral study of the Electrochemical Control of Bacterial Persister Cells (ECCP) focused on developing a technology against drug-resistant and persistent bacteria, which was awarded US patents (US Patent 8,663,914 & US Patent 8,569,027). Also, Dr. Niepa co-founded in 2011 Helios Innovative Technologies Inc. (now PurpleSun Inc.), a medical device company that develops automated sterilization systems to fight bacterial cross-contamination. Since 2017, he leads the microBiointerface Lab (at Pitt) in multidisciplinary approaches to solve problems associated with microorganisms relevant to the environment, healthcare, and food industry. He received numerous awards from the United States National Science Foundation, including **NSF–EHR 1930216**, **NSF–DMR 2104731**, and the 2021 NSF CAREER Award (**NSF–CMMI 2144253)**.

Abstract: The attempts for eliminating infections using antibiotics become abortive because of the versatility of the microorganisms. Microbes secrete enzymes to inactivate the antimicrobials, modify their genetic and phenotypic make-up to persist throughout irregular and ineffective treatments, or develop biofilms to escape the immune system. Consequently, the rapid spread of multi-drug resistant pathogens continues to challenge the treatment of infections with conventional methods. Here, we present novel strategies to eradicate multidrug-resistant microbes with substrate conductive interfaces and nanomaterials. This talk will discuss an electrochemical approach to eradicate opportunistic pathogens (e.g., *Pseudomonas aeruginosa* PAO1, *Candida albicans*) associated with many infections. The electrochemical technology (ECT) alters the metabolic response of cells to sensitize the pathogens to subsequent antibiotic treatments. We also explore the ability of $Ni@SiO_2$ nanoparticles to promote the controlled release of biocides and kill microbes upon sensing microenvironmental changes. While the nanoparticles alone exhibit excellent biocompatibility, the controlled release of delafloxacin from the metallodrugs complexes contribute to their antimicrobial activity. These strategies could potentially lead to disruptive technologies and devices for eradicating drug-resistant infections. His seminar will also present the research opportunity to acquire an advanced degree in his lab at Pitt, a research-intensive university in the U.S. Dr. Niepa will discuss the application process for joining the M.S. and Ph.D. programs in engineering at Pitt.