Paper ID: 53056
oral

IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Science Results from Ground Based Research (4)

Author: Prof. Christopher Lambert
United States, clambert@wpi.edu

Mr. Ty Moquin
Worcester Polytechnic Institute, United States, tfmoquin@wpi.edu
Mr. Achilles Gatsonis
Worcester Polytechnic Institute, United States, agatsonis@wpi.edu
Mr. Jared Watson
Worcester Polytechnic Institute, United States, jdwatson@wpi.edu
Mr. Aung Lynn
Worcester Polytechnic Institute, United States, ahlynn@wpi.edu

EARLY TIME BACTERIA ADHESION ON CHANNEL SURFACES UNDER TERRESTRIAL GRAVITY

Abstract

We present initial results from research that utilizes an innovative miniaturized flow-through bioreactor to investigate the effects of gravity, shear, mean flow, and bacteria concentration (referred to as microhydrodynamics) as well as surface topology and chemistry, on the migration of bacteria and subsequent biofilm formation on a surface. The bioreactor is referred to as Microhydrodynamics of Biofilms in Channels (MOBIC) and is a high throughput design with sixteen controlled surface coupons (CSCs). MOBIC allows rapid identification of the relative affinity of bacteria to a surface under a single set of inlet flow conditions and provides for monitoring of biofilm formation in real time. By attaching the MOBIC onto a clinostat we will examine the effects of microgravity on biofilm formation. In this study, we develop a custom designed electrochemical impedance spectroscopy (EIS) system that allows real-time monitoring of bacterial adhesion and the early steps in biofilm formation under terrestrial gravity conditions. The mechanical properties are investigated using atomic force microscopy (AFM) to obtain force spectroscopy data. The electrochemical and mechanical properties of bacterial adhesion and biofilm formation under different flow conditions and with different surface chemistries have been characterized. EIS and AFM data show that the electrochemical and mechanical properties of bacterial adhesion and biofilm formation are significantly influenced by flow rate and the surface chemistry. For the bare surfaces, higher flow rates result in an increase in the impedance and Young's modulus of the biofilm, suggesting that an intact biofilm is formed. However, surfaces modified with Daptomycin (a cyclodecapeptide antibiotic) show no significant changes in impedance but a high Young's modulus is found regardless of flow rate, implying that the antibiotic may result in a porous but a more rigid structure to the biofilm. These combined methods could provide invaluable insight for understanding the development of biofilm on the surface under environmental stress. This work will be extended in studying effects of microgravity on the biofilm formation and structure.