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Session M33: Microscopic Self-Assembly I

8:00 AM–10:48 AM, Wednesday, March 8, 2023
Room: Room 225

Abstract: M33.00001 : Microbial interaction with micrometer-scale wrinkled surfaces subjected to fluid shear

8:00 AM–8:12 AM

Abstract

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Surface properties influence bacterial adhesion, which is the first step towards colonization and biofilm formation. For implantable devices, such as catheters, biofilm-associated infections are the most common clinical complications, given their resistance against mechanical stress and antibiotics; therefore, it becomes of paramount importance the design and fabrication of surfaces able to prevent or reduce bacterial colonization. We investigated the effect of micrometer-scale surface wrinkled topographies subjected to fluid shear on the attachment and proliferation of different bacterial species and strains characterized by defined shape (spheroidal *Staphylococcus aureus* and *Enterococcus faecalis*, rod-like *Pseudomonas aeruginosa* and *Escherichia coli*) and motility (motile, non-motile). Specifically, sinusoidal (1D), checkerboard (C), and herringbone (H) patterns were fabricated by mechanical wrinkling of plasma-oxidized polydimethylsiloxane (PDMS) bilayers and contrasted with flat (F) surfaces. In static conditions, microbial deformation and orientation were found to correlate with the aspect ratio and commensurably with surface pattern dimensions and local pattern order, ultimately describing a linear scaling between bacterial areal coverage and available surface area. Furthermore, to evaluate the effect of topography over bacterial attachment in dynamic conditions, 1D wrinkled topographies were incorporated into microfluidic channels oriented according and in opposition to the flow direction. Significantly, the combination of topography and flow is found to disrupt the spatial arrangement of bacteria, impeding proliferation for several hours and reducing it (by up to ~50%) thereafter compared to flat (F) surfaces. Our findings suggest an effective framework to rationalize the impact of micrometer-scale topography, in static and dynamic conditions, and demonstrating that the judicious combination of surface patterning and fluid shear provides an effective strategy to delay and frustrate the early stages of bacterial proliferation.