Imaging and Monitoring the Stages of Biofilm Formation

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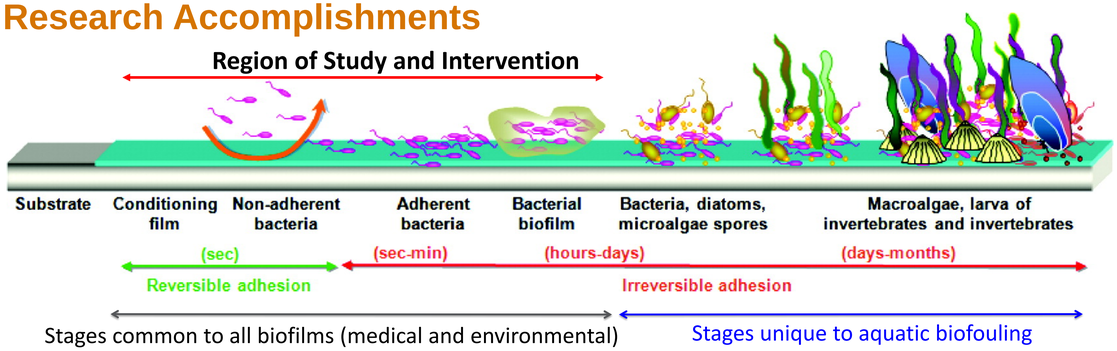
Purpose

- Examine biofilms and biofouling processes from medical and marine environments to understand and compare the basic mechanisms for each type.
- Develop new analytical tools to enable effective measurement of biofilms and support rational development of better antifouling materials.

Expected Outcomes and Impact

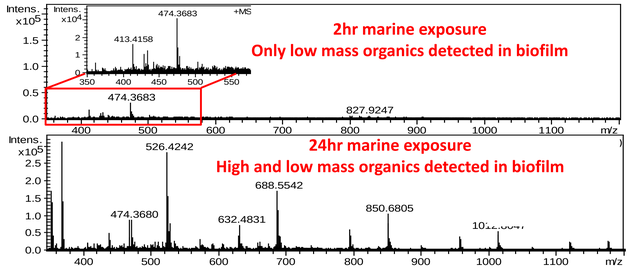
- Improved and novel analytical methods to study biomolecular processes at the fluid-surface interface.
- Identify how conditioning film composition and distribution impacts cellular adhesion and colony formation.
- Improved mechanistic understanding of how surface chemistry and features impact biofilm formation to enable rational development of new antifouling materials.
- Develop better antifouling surfaces to improve shipping fuel efficiency, reduce invasive species transport, reduce infections from medical devices.

Research Accomplishments



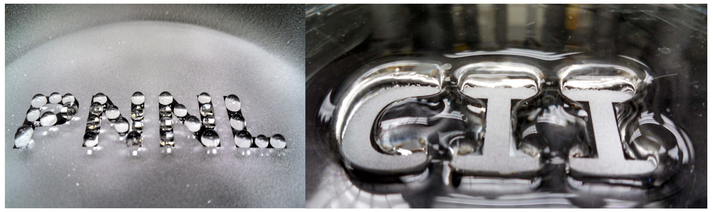
Chemical Characterization of Biofilms

- Total Organic Carbon
- MALDI-TOF



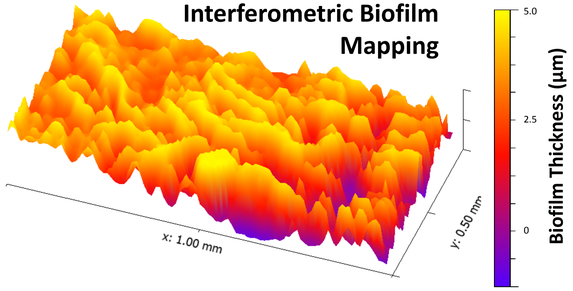
Study of Novel Biofilm-Resistant Surfaces

- Biomimetic (i.e., shark skin and lotus leaf structures)
- Novel paintable super hydrophobic self-healing surfaces



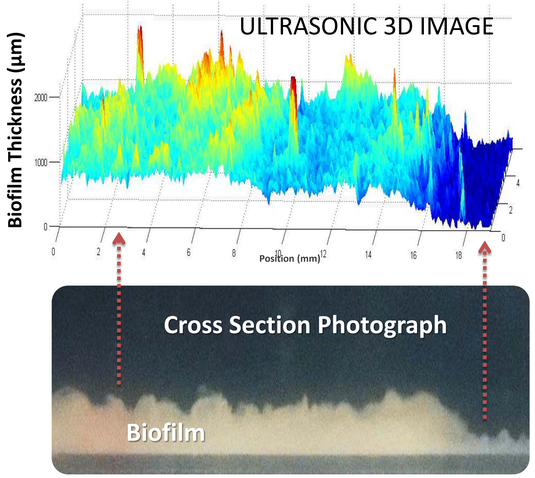
In-situ Imaging and Quantification of Biofilms

- Digital Quantification of Biofouling
- X-ray Microtomography
- Ultrasonic Imaging (2D to 3D to 4D)
- Optical Interferometry



Key Successes (Yr1)

- Novel biofilm characterization and imaging methods demonstrated
- Novel antifouling interface created



Other Methods to Be Evaluated

- Atom-Probe, TOF-SIMS, AFM-Raman
- Optical Imaging (STORM and SIM)

Next Steps

- Finish methods development and publish results
- Apply methods to mechanistic study of antifouling materials
- Begin ASTM method certification process
- Write proposals for follow-on funding to ONR, NIH, DOE, and Special Programs clients