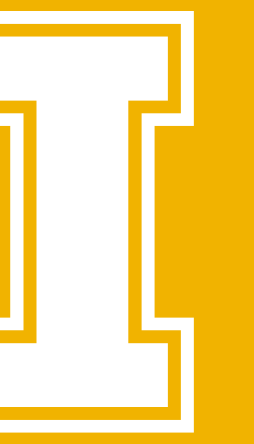


PAYLOAD DESIGN TO EVALUATE BIOFILM RESISTANT COATINGS FOR SPACECRAFT WATER SYSTEMS

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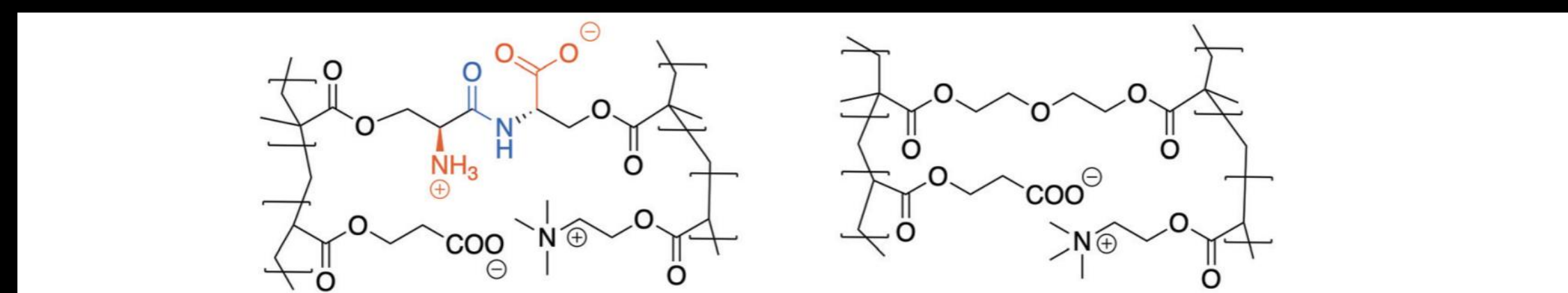
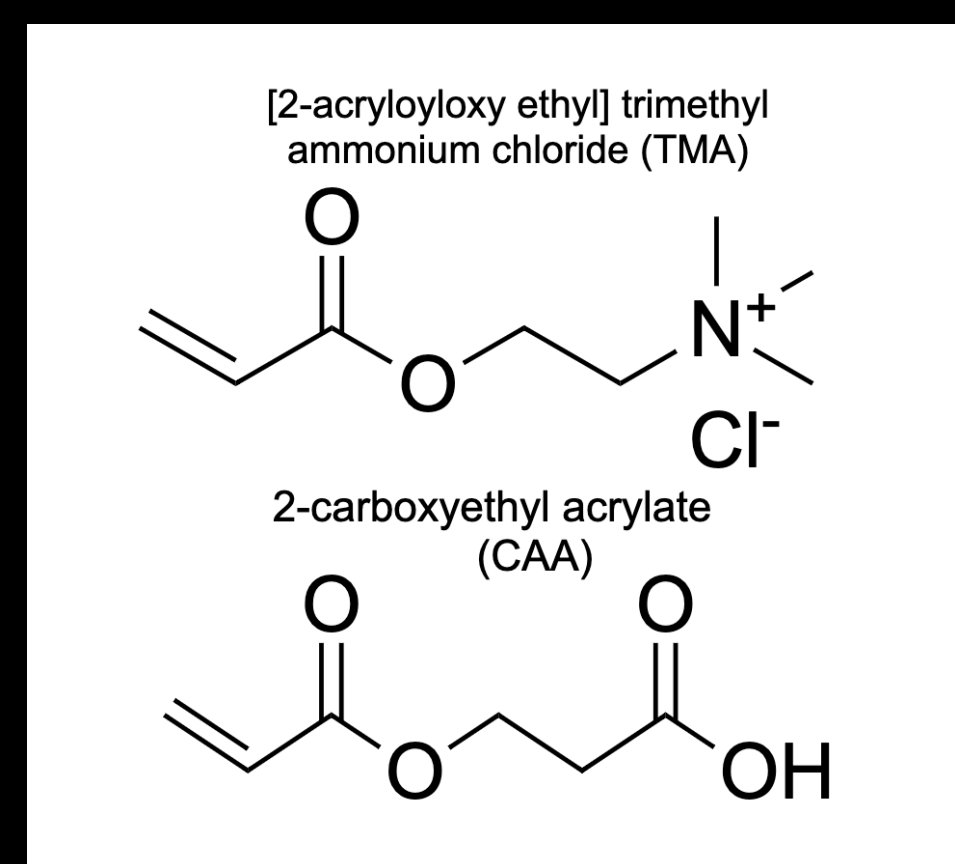
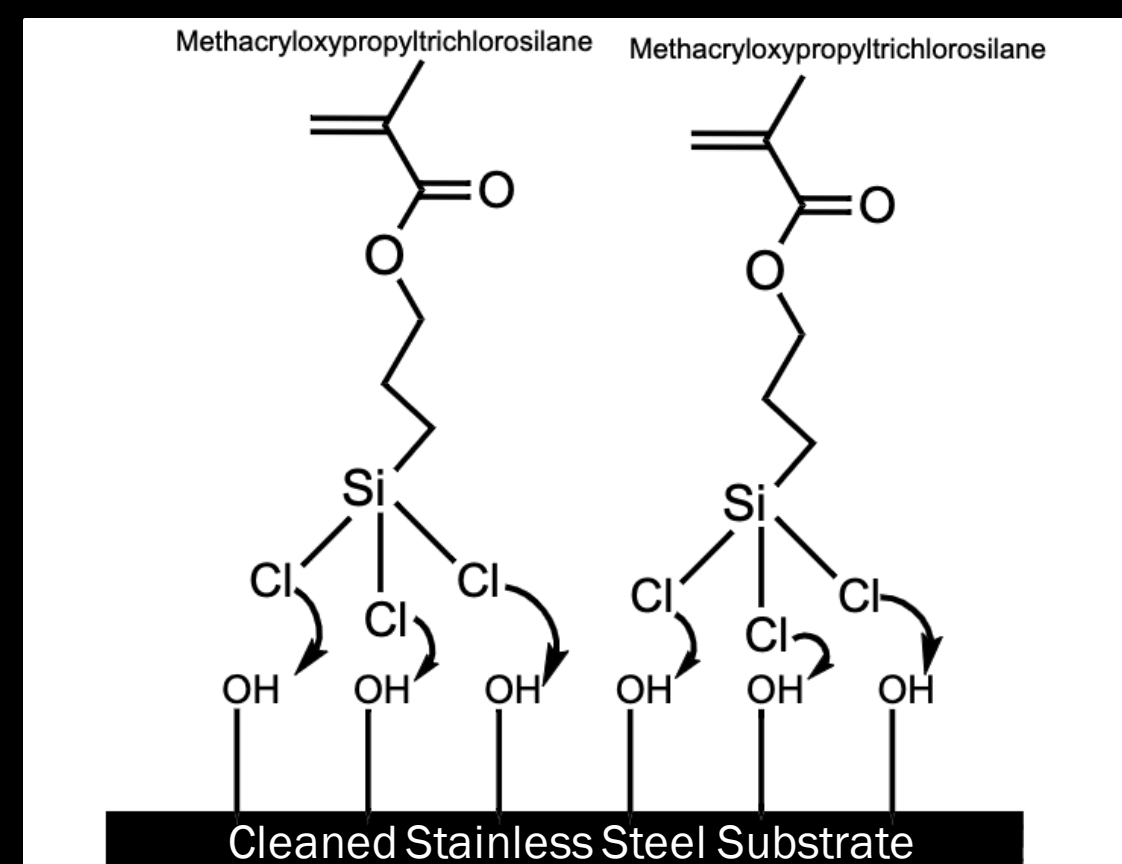
BACKGROUND

- Bacteria strains *Ralstonia picketti* and *Burkholderia cepacia* identified at concerning levels on the ISS water system
- Designed an experimental apparatus to be sent to ISS
- Testing the effectiveness of bacterial resistant polymer coatings on stainless steel for inhibition of bacterial attachment

REQUIREMENTS

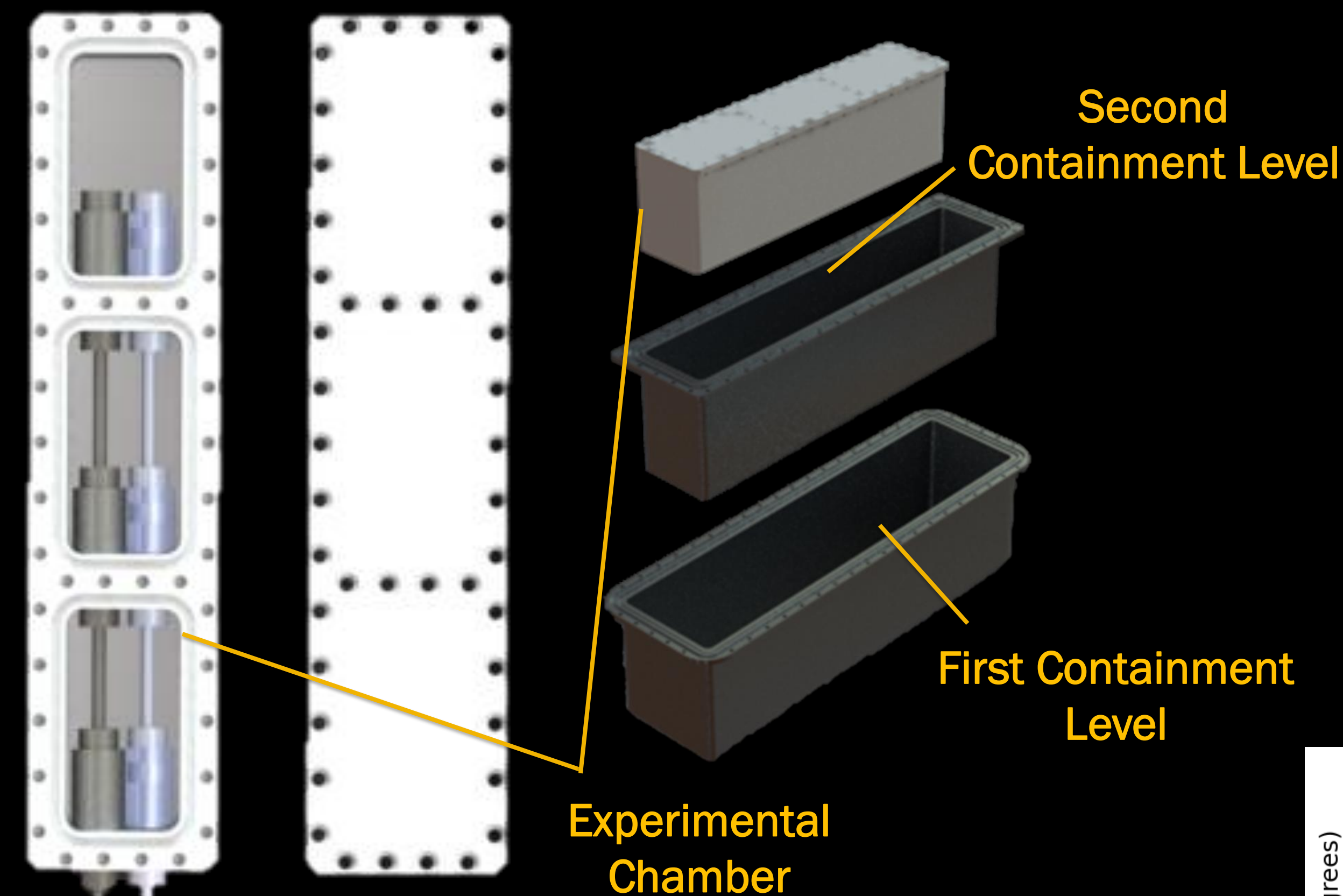
- Maximum dimensions: 3.75" x 3.5" x 12"
- Experimental apparatus cannot exceed 3.8 kg
- Start operation on powerup without user interface
- Three chambers: *R. picketti*, *B. cepacia*, Co-culture
- Biosafety Level 2 requires three levels of containment
- Double redundancy in bacteria release system

POLYMER COATINGS



- Substrate surface initiated using methacryloxypropyltrichlorosilane
- Coatings synthesized with TMA and CAA monomers
- Studied effect of cross linkers and film thickness on biofilm adhesion
- Random copolymerization occurs due to natural charges of the monomer units and the zwitterionic crosslinker

EXPERIMENTAL BUILD



- "Nesting Doll" design allows for triple containment
- Two linear actuators dispense bacteria into chambers
- Media mixed by caged stir bar
- DC motor with attached magnets induces stirring
- Electronics controlled by Arduino Teensy 4.1

BACTERIA TESTING

- Optimal growth medium determined to be Luria Broth
- Temperature and pH increased during growth phase
- Confirmed no off-gassing or pressure buildup in chambers

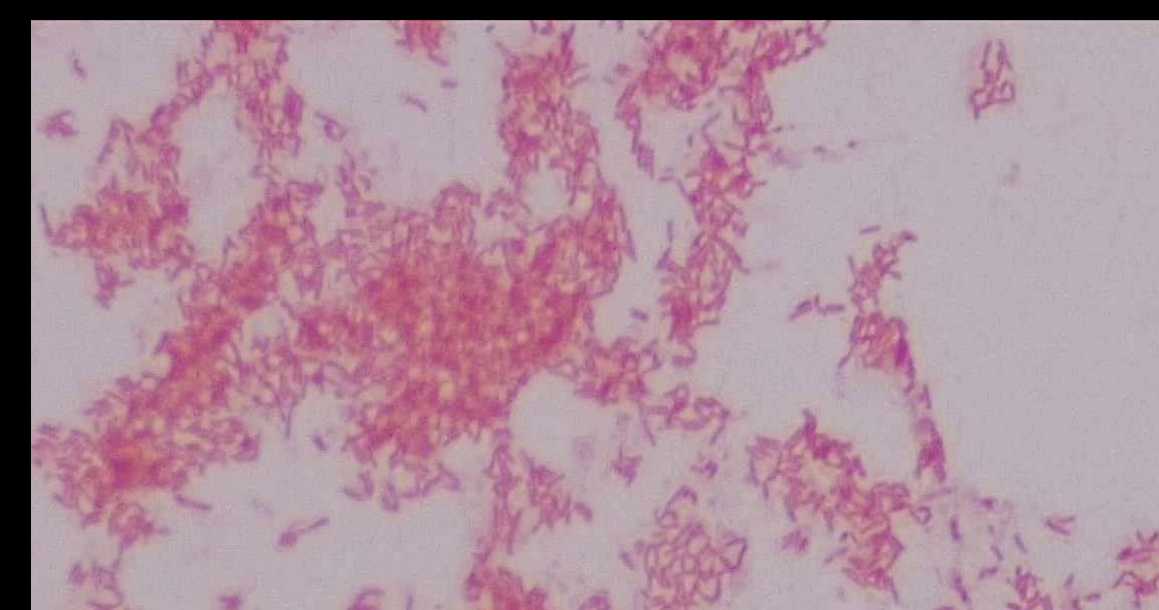


Fig 1: Microscopic Image of *Burkholderia cepacia*



Fig 2: Experimental apparatus to test biofilm growth conditions and polymer validation

DATA ANALYSIS

Image Analysis

- Auto-analysis program that isolated biofilm growth on tested surfaces
- Calculated total area of biofilm as a percentage

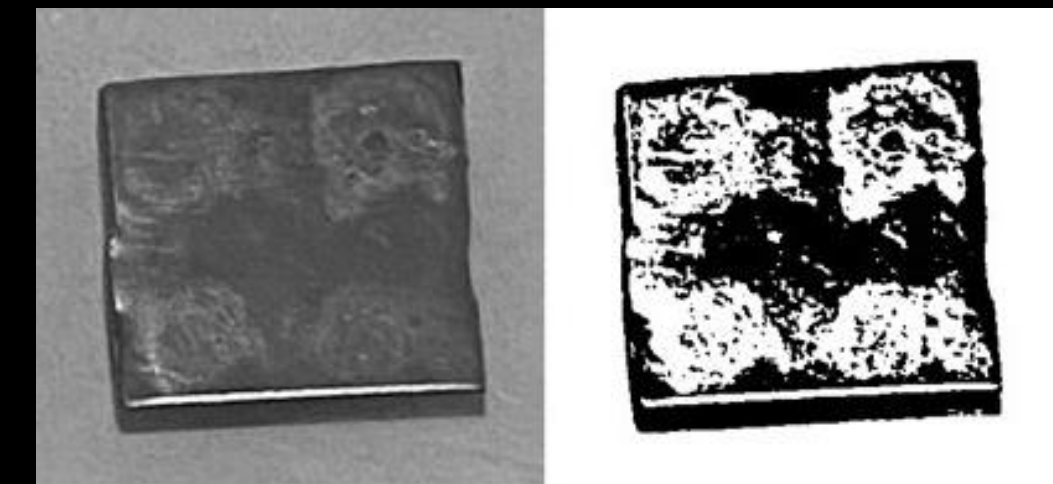


Fig 3: Isolating Biofilm Growth

Contact Angle

- Measured contact angle of polymers to quantify wettability
- Combined with biofilm area data to show relationship between hydrophobic character and bacteria resistance

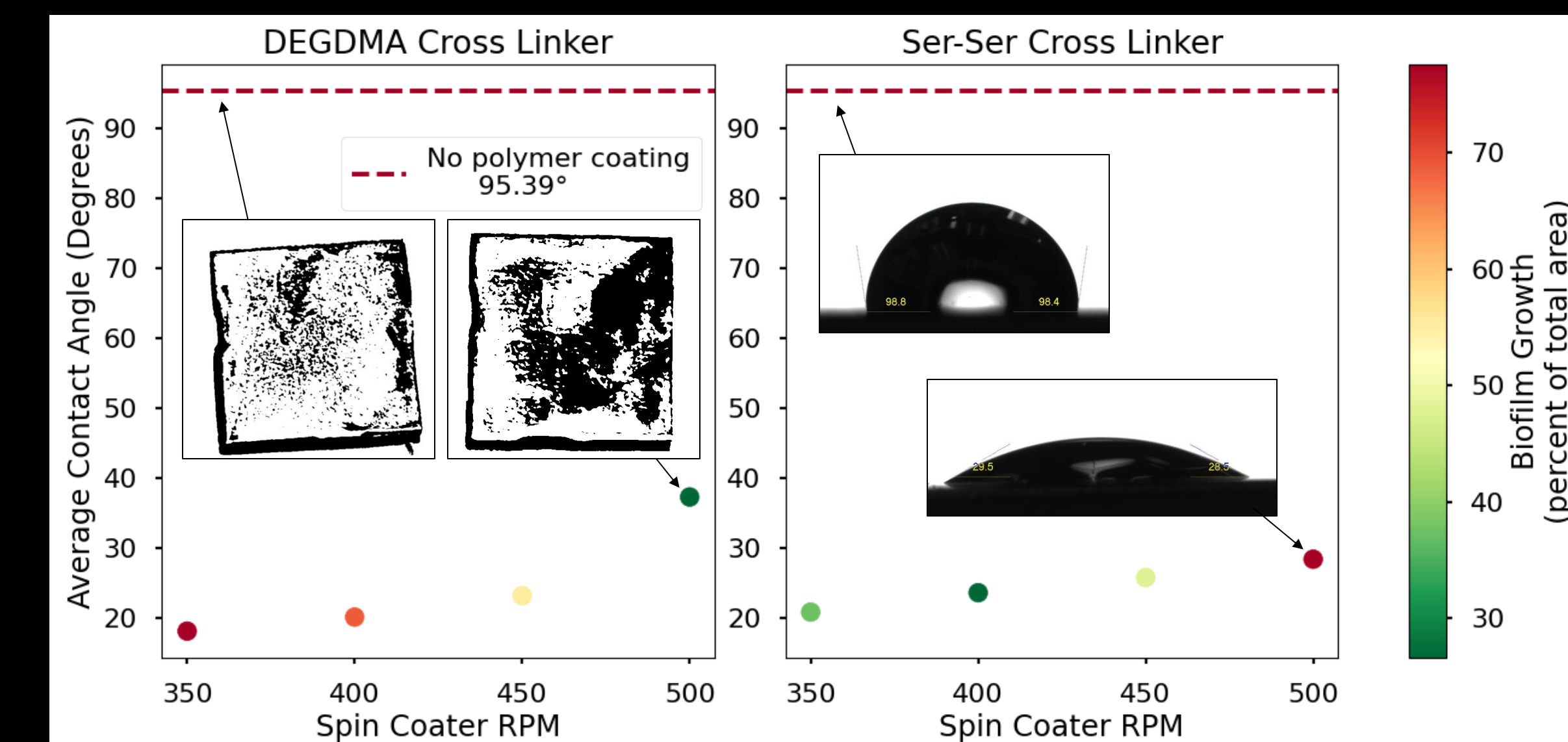


Fig 4: Contact angle of polymers compared to biofilm growth

TEAM



Acknowledgements

- Adrienne Shea, *mentor*
- Zane Holliday, *mentor*
- Sharjeel Jokhio, *mentor*
- Charles Cornwall, *machinist*

Funding

Grant # 80NSSC22M0120



University of Idaho
College of Engineering

2023 Capstone Project