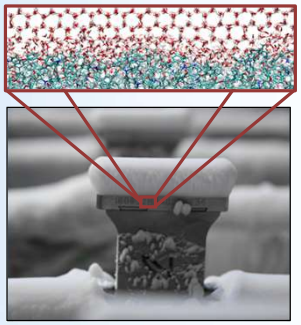
National Aeronautics and Space Administration

Designed Adhesion

Exploring the Unknown



Numerical simulations of the molecular dynamics of ice on an epoxy substrate (above) and an experimental ice growth on a test coupon (left).

CHALLENGE

Technical Challenges

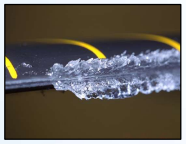
- Mechanisms of adhesion are not well understood
- Lack of ability to navigate parametric space (design/optimize)
- Behavior of adhesives in adverse conditions (extreme heat/cold)
- Scalability of fabrication
- Lack of standardization/precision in evaluation methods

Regulatory Challenges

- FAA – Requires exact quantitative assessment of material properties
- EPA – Regulates materials under the Toxic Substances Control Act
- FDA/USDA – Regulates genetically modified organisms

EXPECTED IMPACTS

- Ability to navigate the large parametric space of adhesion to:
  - Optimize/design materials for targeted purposes
  - Quantify the behavior of materials to a level sufficient for certification and market entry.
  - Utilize novel adhesive materials that lead to efficient, sustainable, reusable and/or maintainable aircraft components.



Anti-Icing

Insect residue

Interiors

Structural

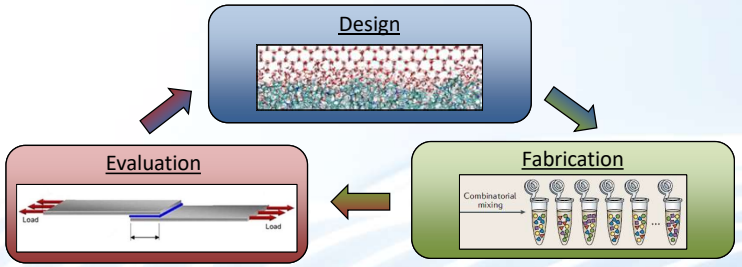
Continuum of Adhesion

RESULTS

- Completed the Opportunity Concept Study that reached out to stakeholders and identified the primary barriers prohibiting innovation.
- Stakeholders included researchers, industry and government entities and included:
  - Collins Aerospace
  - NASA SMD
  - Purdue University
  - Fusion Bionic GmbH
  - Mussel Polymers Inc.
  - NASA STMD CUBES Project

PROPOSED SOLUTION

- Design: Use computational tools to evaluate and design adhesives and substrates that meet application needs.
- Fabricate: Manufacture adhesives and substrates for evaluation.
- Evaluate: Test the adhesion properties of adhesives and ice/substrate configurations and feed knowledge back into the design phase



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