Adhesives and Interfaces / Bio-based Adhesives

S&T Campaign: Materials Research
Biological & Bio-Inspired Materials and High Strain Rate & Ballistic Materials

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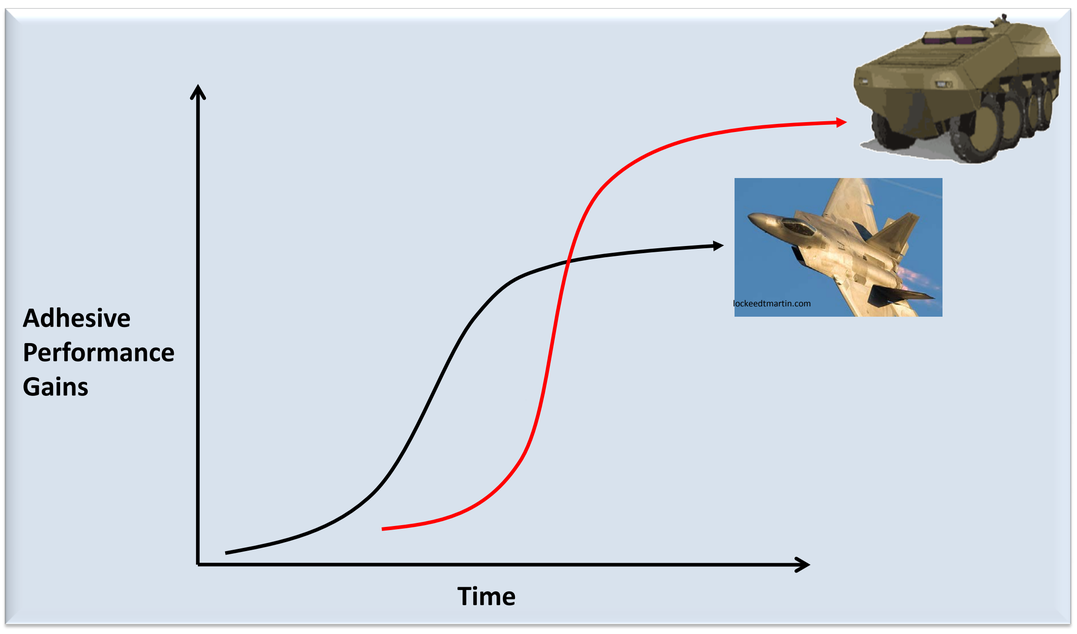
Research Objective

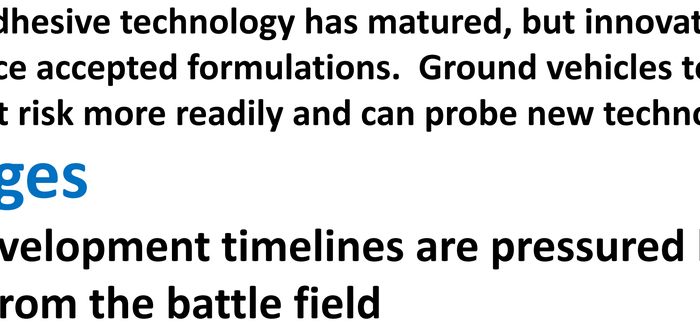
- **Drive state-of-the-art adhesion performance past historical benchmarks established by aerospace.**
- **Describe how this research pushes the boundaries of the state of the art in the research field**



Aerospace adhesive technology has matured, but innovations may not displace accepted formulations. Ground vehicles tolerate component risk more readily and can probe new technologies.

Challenges

- **Army development timelines are pressured by emerging threats from the battle field**
- **> 400 commercial adhesive formulators**
- **Engineering data difficult to obtain outside of aerospace applications**
- **Army demands performance under unique high loading rate and other extreme environments (temperature & humidity extremes)**

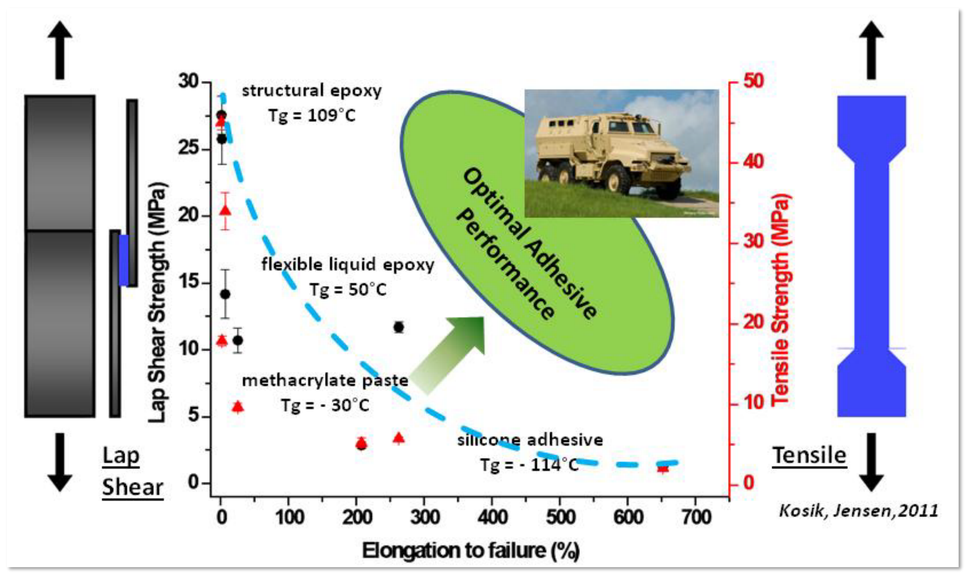


Plots of generic adhesive performance under variable strain rate and humidity conditions. Quasi-static performance may not reflect high rate characteristics; the adhesive bond interface is more susceptible to degradation by adventitious moisture than the bulk of the adhesive.

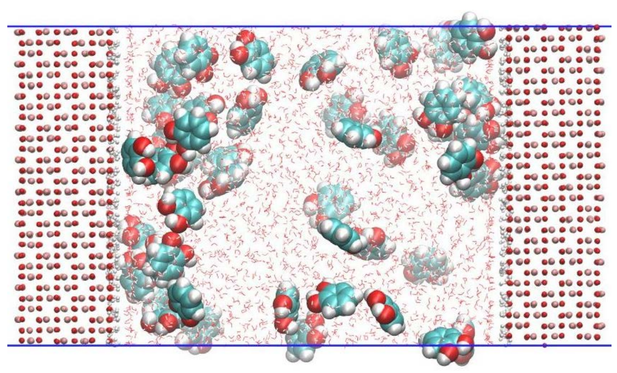
KEY CHALLENGE:
Can materials informatics and new approaches to adhesive design be coupled to tune performance across a broad range of environments?

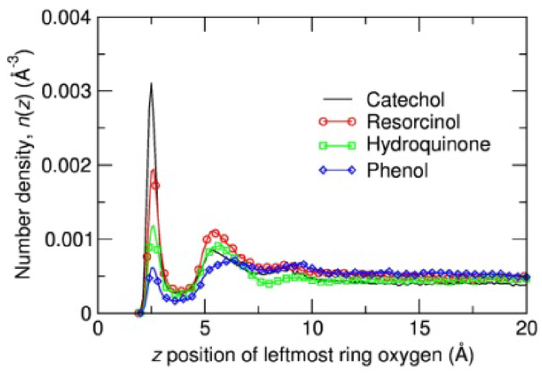
ARL Facilities and Capabilities Available to Support Collaborative Research

- **Full suite of mechanical testing capabilities, focused on tensile and shear failure modes**
- **Computational modeling of adhesive interfacial interactions, polymer network interactions**
- **Expansive characterization capabilities including XPS, SEM, TEM, FTIR microscopy, RAMAN microscopy, AFM**
- **MSAT database with pedigreed dataset, acquisition protocols**



Current adhesives encompass a wide range of performance tradeoffs but are not optimized for Army applications.





Modeling catechol & related compound interactions with an alumina substrate in an aqueous environment.

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- **ARL has established accepted protocols for adhesives testing, welcomes novel adhesives for database inclusion (Jensen et al., ARL-SR-288, June 2014).**
- **Novel techniques for characterizing interfaces or surfaces are welcomed.**

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