Spring 2024 Joint Colloquium
Materials Department & Materials Research Laboratory

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Materials Design for Hypersonics: From Bench Top Engineering to Live Flight Testing Beyond Mach 5

Hypersonics refers to flight and aerodynamic phenomena that occur above Mach 5 (5 times the speed of sound). To frame hypersonic speeds, a non-stop flight from Los Angeles to Tokyo aboard a commercial airliner (Mach 0.8) takes roughly twelve hours, whereas onboard a Mach 9 hypersonic vehicle it takes one. Candidate vehicle systems with ever-increasing capabilities and Mach numbers are being developed, including boost-glide systems, reusable aircraft, and space-launch vehicles. However, these remarkable leaps in Mach number and performance during atmospheric flight come with an array of formidable materials challenges associated with extreme aerothermal environments. The scope of this presentation will highlight several key topics:

- An introduction to critical hypersonic vehicle areas such as aerostructures and thermal protection that demand materials withstand superheated atmospheres (>2000°C), extreme thermal gradients, and harsh oxidizing conditions. Relevant refractory compositions, thermal protection systems, and their associated properties will be discussed.
- Strategies for advancing laboratory-scale materials and technologies to manufacturable flight-ready components through advanced materials testing techniques ranging from arc-jet testing to flight at Mach 5+. This includes emerging techniques such as selective laser reaction sintering and testing of traditional thermal protection technologies.
- The first live flight demonstration of Stratolaunch Talon-A - an autonomous, reusable hypersonic testbed designed to fly experiments, emerging materials, and payloads in the Mach 5+ hypersonic environment.

Bio: Adam Peters received his BS in Chemistry from U.C. Santa Barbara and his PhD in Materials Science and Engineering from Johns Hopkins University. As a fellow at the Johns Hopkins Applied Physics Laboratory, his doctoral work was focused on the development of an additive manufacturing process called selective laser reaction sintering (SLRS) – which synthesizes ultra-high temperature ceramics during part formation in reactive atmospheres. This work led him to co-found Synteris, a start-up focused on commercializing SLRS for the production of complex refractory components for extreme environment applications. Adam currently serves as Principal for Advanced Programs (Materials and Aerostructures) at Stratolaunch, a reusable hypersonic vehicle developer that conducts live hypersonic flight testing.

Hosted by Dan Oropeza