ABSTRACT

Future deep space exploration will face significantly harsher environments, necessitating the design and manufacturing of human-made space structures and propulsion systems with more complex geometries, compositions, and enhanced performance. While additive manufacturing (AM) opens up new possibilities for innovative structures and materials suitable for such harsh environments, the unique properties (e.g., high chemical stability in ceramics, high reactivity in energetics) of these materials pose challenges for their fabrication using existing AM technologies. Ceramics, for instance, demand substantial thermal input to overcome their extreme chemical stability, and energetics require specialized process control and monitoring to prevent accidental ignition during manufacturing, handling, and storage.

Our research is dedicated to the development of novel AM technologies operating under milder conditions than those currently required for extreme materials. In the first part of the talk, I will introduce our work on a mild AM technology for ceramic materials, inspired by the natural rock formation process occurring under ambient temperature. In the second part, I will present our study on a mild AM technology for energetic materials, including propellants and explosives. This technology allows for the fabrication of energetics with switchable sensitivity, mitigating the risk of unintentional ignition during handling while maintaining precise control over energetic performance as needed.