



ABSTRACT

Boosting 3D Printing with Vacuum Technology: Overcoming Challenges for Innovation.

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Fused Filament Fabrication (FFF) in vacuum presents unique opportunities across multiple domains, from space exploration to advanced material science and medical applications. The absence of atmospheric pressure and convective heat transfer creates a fundamentally different processing environment, leading to improved material properties, enhanced energy efficiency, and the ability to integrate physical vapor deposition (PVD coating technologies directly into the printing process. However, further research is needed to address challenges in process control and parameter optimization for PVD enhanced 3D printed polymer.

This presentation will provide an overview of our comprehensive research on 3D printing in vacuum, highlighting key challenges and our solutions for reliable printer components design, process control and slicing parameter optimization. We will delve into strategies for temperature management, including sensor integration and advanced heating mechanisms, as well as essential electrical and mechanical design considerations crucial for successful printing in vacuum environments.

Furthermore, we will discuss the challenges of manufacturing of the PVD enhanced FFF process and evaluate the mechanical properties of printed components with and without integrated coating. Finally, we will discuss applications of this emerging technology, outlining its potential to drive future advancements in vacuum-enabled additive manufacturing.