

## **DIRECT-WRITE ADDITIVE MANUFACTURING OF POLYMER AND CERAMIC COMPOSITES**

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Extrusion-based additive manufacturing (AM) technologies – including fused filament fabrication (FFF) and direct ink writing (DIW) – present opportunities to create composite materials and multi-material architectures that cannot be made using other AM technologies. The direct deposition nature of these processes enable the straightforward deposition of multiple materials through the use of multiple print heads, while the extrusion process preferentially aligns high aspect ratio filler materials like fibers, whiskers, and platelets. This alignment, coupled with the flexibility to choose the print path for each layer provides the ability to prescribe unique fiber arrangements within printed parts.

This talk will focus on recent developments in understanding the relationship between filler morphology, ink rheology, print parameters (i.e. nozzle size and print speed), and the resulting mechanical properties of printed epoxy composites. Novel deposition strategies to print hybrid composite/foam architectures and to control fiber orientation will also be discussed. Finally, the talk will conclude with a brief description of our current work applying the printing strategies developed for epoxy composites to preceramic polymer resins for the creation of high temperature ceramic composites. Current challenges and open questions will be highlighted throughout the talk.