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Colloidal-based additive manufacturing of bio-inspired composites

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Composite materials in nature exhibit heterogeneous architectures that are tuned to fulfill the functional demands of the surrounding environment. Examples range from the cellulose-based organic structure of plants to highly mineralized collagen-based skeletal parts like bone and teeth. Because they are often utilized to combine opposing properties such as strength and low-density or stiffness and wear resistance, the heterogeneous architecture of natural materials can potentially address several of the technical limitations of artificial homogeneous composites. However, current man-made manufacturing technologies do not allow for the level of composition and fiber orientation control found in natural heterogeneous systems. In this talk, I will present two additive manufacturing technologies recently developed in our group to build composites with exquisite architectures only rivaled by structures made by living organisms in nature. Since the proposed techniques utilize colloidal suspensions as feedstock, understanding the physics underlying the stability, assembly and rheology of the printing inks is key to predict and control the architecture of manufactured parts. Our results will show that additive manufacturing routes offer a new exciting pathway for the fabrication of biologically-inspired composite materials with unprecedented architectures and functionalities.