NATIONAL SECURITY SCIENCE AND ENGINEERING FACULTY FELLOWSHIP

PROGRAMMABLE ARCHITECTED MATERIALS

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Technical subject/subcategory: Manufacturing
Science / (a) Programmable Surfaces

PROJECT ABSTRACT

The proposed program of research will establish the *basic science required to create programmable architected materials with extraordinary properties*. Advancement of this science base will enable rapid design and fabrication of heterogeneously integrated, functional and structural materials in unusual, and as yet unimagined, geometric layouts. Towards this objective, we will pursue an innovative scientific and technical approach that focuses on: (1) programmable assembly and disassembly of anisotropic building blocks with spatial and temporal control within tunable polymeric matrices, (2) microscale printheads for programmably encoding local composition, anisotropic filler orientation, and matrix stiffness "on-the-fly" during printing, and (3) new hybrid, rotational, core-shell, and biomimetic printing methods for fabricating complex, multi-material architectures that exhibit exceptional properties and performance. This research will yield the foundational materials science, fluid mechanics, and manufacturing science required for creating programmable architected materials via next-generation 3D and 4D printing techniques. Broad outcomes that enable transformative scientific and engineering advances in flexible electronics, sensors, lightweight composites, and shape-morphing architectures of critical interest to the DoD are expected.