Materials for 3D Functional Mesosystems: From Neural Interfaces to Environmental Monitors

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Complex, three dimensional (3D) micro/nanostructures in biology provide sophisticated, essential functions in even the most basic forms of life. Compelling opportunities exist for analogous 3D structures in man-made devices, but existing design options are highly constrained by comparatively primitive capabilities in fabrication and growth. Recent advances in mechanical engineering and materials science provide broad access to diverse, highly engineered classes of 3D architectures, with characteristic dimensions that range from nanometers to centimeters and areas that span square centimeters or more. The approach relies on geometric transformation of preformed two dimensional (2D) precursor micro/nanostructures and/or devices into extended 3D layouts by controlled processes of substrate-induced compressive buckling, where the bonding configurations, thickness distributions and other parameters control the final configurations. This talk reviews the key concepts and focuses on the most recent developments with example applications in areas ranging from mesoscale microfluidic/electronic networks as neural interfaces, to bio-inspired microfliers as environmental sensing platforms.