Electrostatic assembly of colloidal nanoparticles at the fluid interface
Continuous additive nanomanufacturing at fluid interfaces (CANFI)

Tobias Hanrath; th358@cornell.edu

Concurrent advances in the formation of nanocrystal superlattices and additive manufacturing technique (3D printing) have created a fertile opportunity space for the development of novel nanomanufacturing techniques that enable the production of materials and devices with precisely programmed structure, composition, and function across six orders or magnitude in length scale as illustrated in the figure below. Our approach towards this ambitious goal is to synergistically integrate know-how from the directed self-assembly with emerging additive 3D printing methods. The innovative claim of the proposed CANFI process derives from the synergistic integration of recent advances in directed self-assembly and 3D printing to bridge the manufacturing length scale gap.

Additive manufacturing has quickly evolved to become a powerful and versatile fabrication technique with applications ranging from do-it-yourself 3D printing, to tissue engineering, to materials for energy and emerging printed electronics and many more. Despite this rapid progress, currently available 3D printing technologies have three significant shortcomings: (i) the spatial resolution, (ii) the speed and (iii) the range of material compositions that can be printed.

Controlling the density of the nanoparticles at the fluid interface presents an important challenge to bring the prospects of the CANFI 3D printer to fruition. Our working hypothesis is that the particle concentration at the interface can be dynamically and reversibly tuned through application of a potential bias across the fluid interface. Students working on this project will design, build and test a prototype printer including the electrochemical setup to provide the bias voltage across the interface. The student will interact with other graduate students in the group working on other aspects of the CANFI printer.

Schematic illustration of hierarchical assembly enabled by continuous additive nanomanufacturing at fluid interfaces (CANFI) and deign of CANFI cell integrating stereolithographic