Made in SC Thrust III Rational Design of Interactive Biomaterials

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Biomaterials are synthetic or natural substances that interact directly with biological systems and influence the system’s structural functions. Major advances in cellular and molecular technology over the last decade have enabled the development of a new generation of smart biomaterials [76]. With increasing understanding of the direct spatial and temporal relationships between morphologic and molecular events, scientists have realized that biomimicry of surface and bulk properties of materials has the potential to yield new classes of bioinspired materials. Such materials can facilitate the development cycles of cells to tissues to organs. While cells can respond to chemical features of the underlying substrates containing domains as small as sub-nanometer, it is the topographical features of the substrates, from a nanometer to meso-scale, that effectively modulate many cellular responses, including adhesion, migration, proliferation, differentiation, metabolism and apoptosis. *The overall scientific goal for Thrust 3 is to gain a fundamental understanding of the effect of physical and chemical cues on cellular behavior across a range of length scales. The knowledge gained will be used to create in silico models that will allow the development of new interactive biomaterials and devices.*

The thrust has three main focus areas:

1. Synthesis and biogenic assembly (Molecular and nanoscale)
2. 3D fabrication (nanoscale and microscale geometric features)
3. Biological test beds

Our overall strategy is to identify the desired materials properties, create a system to design these materials in silico, synthesize the material and then fabricate it into the 3D architecture needed. These novel materials and geometries will then be characterized in our biological test beds and the results fed back to the computational core to refine and update their predictive models (Figure 1).

Figure 1

