Silk: A top down approach for protein micro- and nano structures
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Silk features
- Green, all aqueous, and ambient condition processing
- Programmable biodegradability
- Biocompatible, FDA approved
- Remarkable optical and mechanical properties
- Patterning down to the nanometer scale
- Doping with bioactive species

Origins and processing of silk fibroin
- Silk fibroin from Bombyx mori cocoons or genetic recombinant material
- All aqueous dialysis based extraction and purification

Materials formation
- Controlling water content
- Controlling crystallinity (beta sheet content)
- Formation of films, gels, foams, fibers

New silk materials
- Providing additional functionality to silk protein material by:
  - Genetic alteration
  - Chemical modification

Fabrication
- Providing additional functionality to silk protein by adding structure to the material with the following fabrication techniques:
  - Reactive Ion Etching (RIE), Lift off, Embossing, and Molding

Genetic material synthesis
- (Green Fluorescent Silk Protein)
  - N. clavipes
  - Aequorea victoria

Chemical material synthesis
- ( Diazonium functionalization)

Recombinant process
- E. coli
- Fluorescent fusion protein expression

Fluorescent fusion protein expression
- Preliminary test with silk/GFP blend

Fusion
- Combining new silk materials and fabrication techniques to create fluorescent enhancement photonic lattice GFP silk structures.

Future
- Structurally enhanced and genetically encoded protein materials bio sensors.

Summary
- Fabrication techniques are potentially scaleable to nm size features.
- Broad scheme of silk material alteration allows to generate novel biomaterials with unprecedented combination of functions.
- Combination of nano structures and genetically encoded materials could potentially enable a new generation of all protein based devices.

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