BIOMOLECULAR TUBES AND FIBERS

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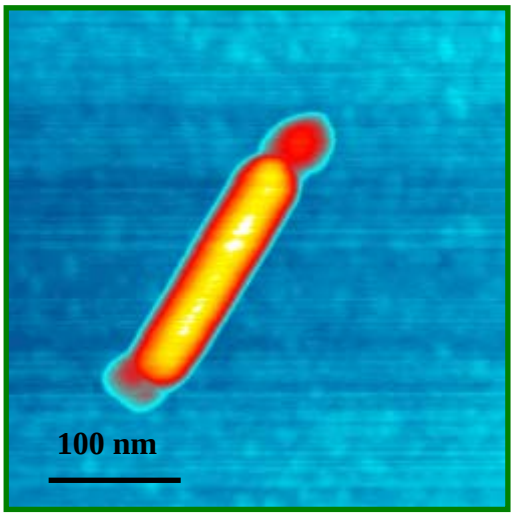
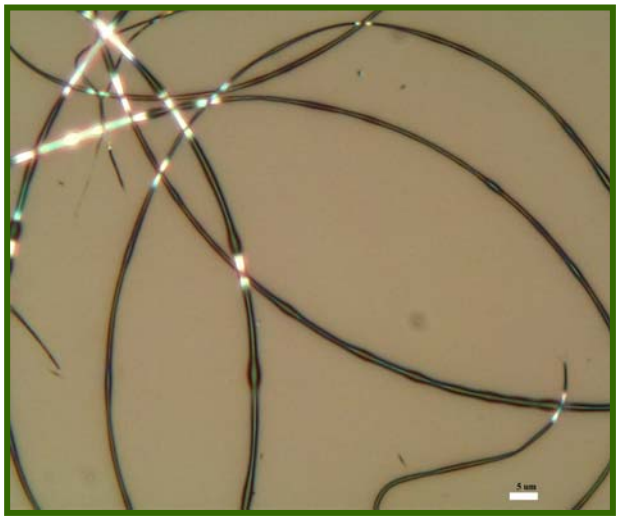
Two methods to assemble peptides and proteins into tubes and fibers will be introduced:

(1) A high voltage is applied a droplet of the material dissolved in a liquid. A jet emerges and hits a counter electrode some cm away. While this method, electrospinning, is well established for polymers, it was only recently adapted to self-assembling monomers such as phospholipids and proteins. We extended this to short peptides, which opens up an apparently quite general method to produce fibers and tubes composed of peptides. The assembly is governed by electrostatic interactions (peptides are zwitterions) and pi stacking of phenyl groups. We also show an alignment method and a possible application for mimicking a part of the Nuclear Pore Complex, an important and very complex gateway to the cell nucleus.

(2) The simplest viruses contain only a single strand composed of nucleic acid and coat proteins. The best known example is the Tobacco mosaic virus, which is pathogenic only for a number of plants. The helically arranged coat proteins and the nucleic acid (RNA) form a 300 nm long tube with an inner channel of only 4 nm diameter. The structure can be metallized and mineralized in aqueous suspension, resulting in unique rod- and tube-shaped deposits with diameters down to 3 nm and lengths up to micrometers. Inspired from the natural self-assembly in infected plants, various strategies can be followed to add even more functionality, e.g. assembly of coat proteins with shortened RNA, mutations, but also chemical reactions at the complete virus.



Gold-virus-gold dumbbell structure



Electrospun di-phenylalanine fibers (scale bar = 5 µm)