

ing tip distance in a stepwise fashion, with a step value equal to the quantum of conductance, until the conductance value almost reached zero. Additional steps with step values of approximately integral multiples of 1/100 of the conductance quantum were observed for 1 mM 4,4'-bipyridine in a 0.1 M NaClO<sub>4</sub> water solution. The researchers attribute these additional conductance steps to the formation of junctions with one, two, three, and more molecules. In order to confirm that the conductance steps were caused by the formation of stable molecular junctions, a solution of 2,2'-bipyridine molecules was tested. In 2,2'-bipyridine, the positions of

two nitrogen atoms prevent the molecule from simultaneously binding to two electrodes, and no conduction steps were observed. The same experiments were performed for hexanedithiol, octanedithiol, and decanedithiol molecules in toluene. The conductance showed stepwise behavior, but the step size was smaller than in the case of 4,4'-bipyridine because of the higher resistance of *N*-alkanedithiol molecules as compared with 4,4'-bipyridine. The researchers said that the resistance of *N*-alkanedithiol molecules corresponds well with the widely accepted model of electron tunneling through the molecule.

MAXIM NIKIFOROV

### "Design Rules" of Silk Production Unraveled in Studies of *Bombyx mori* Cocoons

Traditionally, silk fibers produced by silkworms and spiders are harvested, disentangled, and then woven into fabrics. H.-J. Jin and D.L. Kaplan from Tufts University have begun to unravel the *in vitro* mechanism of silk processing in insects and spiders. As described in the August 28 issue of *Nature*, the researchers monitored the behavior of the silk fibroin solutions as a function of decreasing water content. Starting with the cocoons of the domestic silk moth *Bombyx mori*, the researchers "degummed" the cocoons to generate sericin-free fibroin fibers. The family of sericin proteins is hydrophilic and acts as the glue between fibroin fibers. The sericin in these aqueous fibroin solutions was substituted with polyethylene oxide (PEO). The silk fibroin and the PEO molecules preferentially vie for the water molecules in which the protein is dissolved. As the fibroin concentration is increased and the water content is lowered, micelles form first, ranging in diameter from 100 nm to 200 nm; subsequently, "globules" form as the water content is further decreased. Through scanning electron microscopy and atomic force microscopy, the researchers observed that these globules arise from phase separation between the hydrophilic and hydrophobic segments. Films of the fibroin aqueous solutions were cast and subsequently treated with methanol, physical shear, and stretching. The characteristics of the resulting silk structures depended critically upon the nature of the postprocessing.

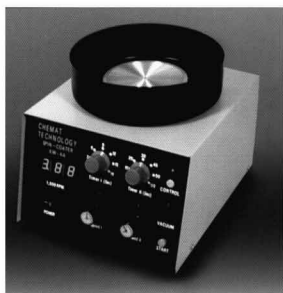
The researchers describe a process that combines the primary sequence of the silk proteins and the biological environment of the gland during silk spinning to create silk fibers. These "design rules," said the researchers, apply to all silk proteins in terms of processing in aqueous environments, which can lead to materials engineering in aqueous systems of new silk-based materials with desired properties for potential applications in tissue engineering and biomaterials.

LARKEN E. EULISS

### Carbon Nanocoil Supports Surpass Performance of Other Nanostructured Materials in Direct Methanol Fuel Cells

T. Hyeon of Seoul National University, Y.-E. Sung of Kwangju Institute of Science and Technology, and colleagues have developed carbon nanocoils as a catalyst support for the fabrication of direct methanol fuel-cell (DMFC) elec-

## Cost-Effective Portable Spin Coater



### Two-Stage Spinning

Dispense liquid during Stage 1  
Spin-up and flatten during Stage 2

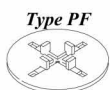
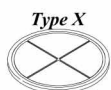
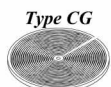
### Adjustable Speed

#### Stage 1

500 to 2500 rpm  
2 to 18 seconds

#### Stage 2

1,000 to 8,000 rpm  
3 to 60 seconds



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