DNA Molecular Template for Oriented Polymer Nanowire Arrays

Yufeng Ma, Jianming Zhang, Guojin Zhang and Huixin He*
Chemistry Department, Rutgers University, Newark, NJ 07102

Like conventional silicon semiconductors, the electrical conductivity of conducting polymer materials can be reversibly varied over many orders of magnitude. This property, together with the fact that conducting polymer materials are mechanically flexible, makes conducting polymer nanowires a rather unique choice both as building blocks of active circuit elements and as wires for circuit interconnections. Despite recent advances, a functional nanodevice using conducting polymer nanowires has not yet been realized. This is largely due to the lack of a good way to fabricate nanowires compatible with device fabrication. DNA, due to its excellent recognition ability, has been used as "smart glue" to guide self-assembly of nanostructures into functional circuits.[1] Since DNA is not a good conductor by itself (still a subject of vigorous debate), one strategy to confer DNA molecules to conduct electrical current is to deposit metals along the DNA strands. Metal wires conduct electricity, but their conductance is not controllable. In this work, doubled stranded DNA strands are stretched, aligned and immobilized on silicon surface, which acted as template to fabricate electrically *controllable* polyaniline nanowire structures on silicon surfaces. Depending on the direction and the shapes of DNA oriented and integrated on the silicon surface, a large arrays of parallel, cross, and "#"arranged polyaniline nanowire arrays are fabricated by exposing the DNA templates to aniline monomer solution, the electrostatic interaction between the protonated aniline and the phosphate groups in the DNA chains emulsifies and organizes the aniline monomers along the DNA chain. The aligned aniline monomers are then polymerized enzymatically by adding Horseradish peroxidase (HRP) and H_2O_2 successively.[2] The use of Horseradish peroxidase enzyme as biological catalysts offers benign reaction conditions, higher degree of control over the kinetics of the reaction. Controlling the polymerization process, polyanline nanowire with different diameters will be formed due to the self-catalysis effect of polyaniline.[3] The morphology, the width, and the heights of the produced nanowires will be studied by tapping mode AFM.

References:

(1) Mbindyo, J. K. N.; Reiss, B. D.; Martin, B. R.; Keating, C. D.; Natan, M. J.; Mallouk, T. E. *Adv. Mater.* **2001**, *13*, 249.
(2) Nagarajan, R.; Liu, W.; Kumar, J.; Tripathy, S. K.; Bruno, F. F.; Samuelson, L. A. *Macromolecules* **2001**, *34*, 3921.
(3) Liao, C. P.; Gu, M. Y. *Thin Solid Films* **2002**, *408*, 37.