Electroless Plating of Protein Templates for the Fabrication of Straight Nanowires on Silicon[1]

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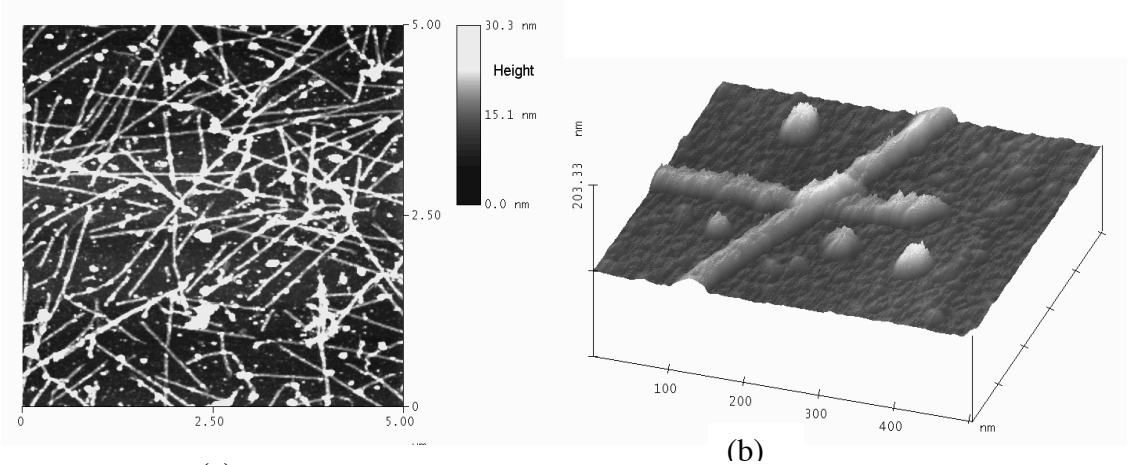
In recent years, the exponential growth in semiconductor technology has been sustained by extending the capabilities of top-down manufacturing processes to smaller and smaller dimensions. Unfortunately, the costs of these top-down approaches are becoming prohibitive at sizes and tolerances in the nanometer size range. In response, a new paradigm has arisen for the mass replication of nanoscale electronic circuits based on a bottom-up, molecular engineering approach that promises to be cheaper, more flexible, and efficient. In particular, control of device interconnections emerges as one of the major challenges in the development of these bottom-up approaches. Research suggests that proteins and assemblies of proteins offer the control necessary for inexpensive and reliable fabrication of nanoscale interconnects. Our interdisciplinary team is exploring the possibility of using cytoskeletal microtubule (MT) protein structures as templates for fabricating nanoscale interconnects, interconnect arrays and networks. MTs are self-assembling, dynamic, tubular shaped biopolymers with nanometer size diameters and large aspect ratios that can be metallized for increased electrical conductivity. Metallization of MTs with Ni via electroless plating is a well-known process resulting in 10nm thick Ni-based films on the outer surface of MTs[2]. MTs metallized in a bulk solution loose their linearity and exhibit bends, kinks, and crooked shapes as a result of stresses. The development of straight metallized MTs is a prerequisite to the formation of useful nano-interconnects. We have developed a process for the fabrication of straight nanowires by metallizing MT templates on a silicon wafer (see atomic force microscopy picture of Ni-coated MTs at (a) low magnification, and (b) high magnification). Interactions between the surface substrate and MTs stabilize the protein structures yielding linear nanowires with partial coating around the tubule cross section.



(a) (b)

References
[1] For further information about this project send email to deymier@u.arizona.edu

[2] M. Mertig, R. Kirsch and W. Pompe *Applied Physics A*. **66** S723 (1998).