# NANO HIGHLIGHT
## Controlled nucleation and growth of protein templates for the fabrication of nano-interconnects

*NSF NIRT Grant 0303863*

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Our work focuses on developing technology for bottom-up approaches to nano-electronics manufacturing inspired by biological processes. We have demonstrated a significant progress toward the fabrication of nanoscale interconnects on silicon wafer by controlled nucleation and growth of protein-based templates from metal electrodes on microchips. Microtubules (MT) are self-assembled subcellular proteinaceous filaments with nanometer scale diameters and micrometer scale lengths. MTs are excellent template candidates for the fabrication of nanowires. MTs are polymerized from two protein monomers, _- and _-tubulin. γ-tubulin, a tubulin isoform, is believed to serve as nucleating agent prior to microtubule growth. We have synthesized a recombinant fusion protein of GST(Glutathione s-transferase) and γ-tubulin through cloning of genetically modified *E. Coli* bacteria. To nucleate MT growth we have functionalized the surface of gold electrodes on silicon wafers with γ-tubulin using the molecular assembly illustrated in figure 1.

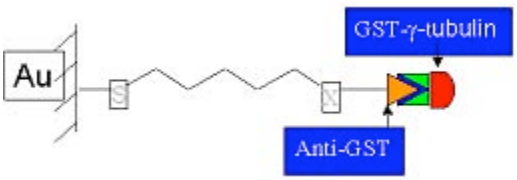
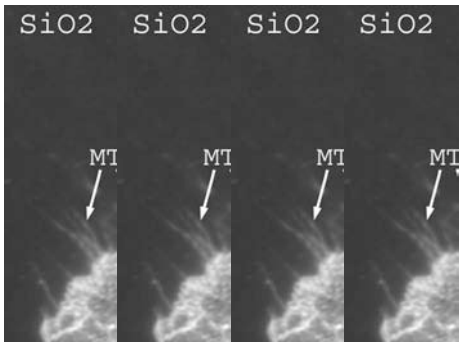


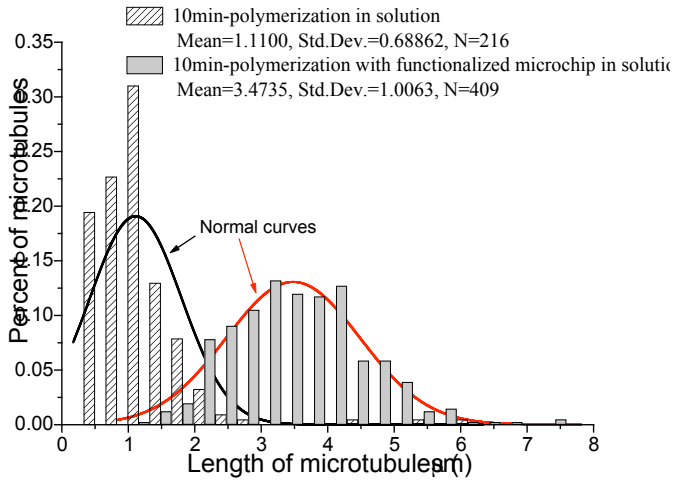

**Fig. 1**: Schematic of molecular assembly for functionalizing a gold surface. The fusion protein GST- _-tubulin binds to anti-_-tubulin antibody, linked to a carboxylic acid terminated self-assembled alkylthiol monolayer covalently bonded to the gold via sulfur groups (S).

When immersed in a solution containing _ and _ tubulin, the assembly of MTs is controlled by nucleation at the functionalized electrode as shown in Fig. 2(a). This process leads to MTs

**(a)** **(b)**



attached and growing from the electrodes that can be subsequently aligned and directed by flow




over the surface (Fig. 2(b)).