The Bio/Nano Interface Template-Synthesized Nanotubes in Bioseparations and Biosensors

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Beginning in the 1980's the Martin research group has pioneered a versatile approach for preparing nanomaterials called template synthesis. This method entails synthesizing nanoscopic particles of the desired materials within the pores of a nanopore membrane or other solid. Because the membranes used contain cylindrical pores with monodisperse diameters, corresponding cylindrical nanoparticles are obtained. Depending on the material and the chemistry of the membrane, these cylindrical nanostructures may be either solid (nanowires) or hollow (nanotubes).

We have been especially interested in biomedical applications of template- prepared nanotubes. We have shown that the template method can be used to make synthetic polymer membranes that contain monodisperse, cylindrical nanotubes that span the complete thickness (10 mm) of the membrane. The inside diameter of the nanotubes can be controlled at will, down to molecular dimensions (¡1 nm). Furthermore these nanotubes can be composed of nearly any material e.g., carbons, metals, polymers, semiconductors.

One area of interest concerns using these nanotube-containing membranes as highly selective molecular filters for bioseparations. We are especially interested in membranes for enantioseparations - one of the most challenging and important problem in modern biomedical science. In addition, we have recently shown that these nanotube-containing membranes can be used for protein separations. We have also shown that these tube- containing membranes can be used in a new approach to biosensing. We have achieved detection limits with these nanotube sensors as low as 10-11 M. Both the bioseparations and biosensors applications entail immobilization of biochemical molecular-reagents - antibodies, enzymes, DNA, etc. - to the inside nanotube walls. Various aspects of this bio nanotube research effort will be discussed in this presentation.