

Protein Biosensors Based on Biofunctionalized Conical Gold Nanotubes

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There is increasing interest in the concept of using nanopores as the sensing elements in biosensors. The nanopore most often used is the α -hemolysin protein channel, and the sensor consists of a single channel embedded within a lipid bilayer membrane. An ionic current is passed through the channel, and analyte species are detected as transient blocks in this current associated with translocation of the analyte through the channel-stochastic sensing. While this is an extremely promising sensing paradigm, it would be advantageous to eliminate the very fragile lipid bilayer membrane and perhaps to replace the biological nanopore with an abiotic equivalent. We describe here a new family of protein biosensors that are based on conically shaped gold nanotubes embedded within a mechanical and chemically robust polymeric membrane. While these sensors also function by passing an ion current through the nanotube, the sensing paradigm is different from the previous devices in that a transient change in the current is not observed. Instead, the protein analyte binds to a biochemical molecular-recognition agent at the mouth of the conical nanotube, resulting in complete blockage of the ion current. Three different molecular-recognition agents, and correspondingly three different protein analytes, were investigated: (i) biotin/streptavidin, (ii) protein-G/immunoglobulin, and (iii) an antibody to the protein ricin with ricin as the analyte.