228c Carbon Nanotube Based Biomimetic Membranes

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Biological ion channels play a critical role in the transport of fluids and chemicals across cell membranes. Synthetic nanopore membranes can be used to mimic ion channels provided the molecular transport through these membranes is precisely controlled. A major challenge associated with the use of synthetic membranes to mimic biological systems is instilling them with reversible gating properties. Nanotubes/fibers from carbon or inorganic materials can be assembled to construct higher order supramolecular architectures within polymer films/membranes. An aligned array of carbon nanotubes impregnated in a polystyrene matrix can be used as a model system to mimic protein ion channels. Open tips of the carbon nanotubes in this membrane have carboxyl functionality and can be easily derivatized with a molecule that binds to a bulky receptor, which can thus regulate the flow through the pore entrance. A nine residue synthetic peptide containing a serine residue [G-R-T-G-R-R-N-S-I-NH2], which is a specific substrate of Protein Kinase A was functionalized at the tip of carbon nanotubes to obtain a biomimetic system where phosphorylation regulates ligand-gated ion channels. The serine residue was phosphorylated using ATP in the presence of protein kinase. Monoclonal Anti-Phosphoserine antibody (mouse IgG1 isotype) derived from the PSR-45 hybridoma recognizes phosphorylated serine, both as free amino acid or within a peptide. Phosphorylation of the serine residue with a kinase leads to the binding of a monoclonal anti-phosphoserine antibody. This binding event controls the ionic flow through the pores. Dephosphorylating the serine residue with an alkaline phosphatase alters the flow through the channels. The transport of oppositely charged molecules through the CNT membrane was quantified. This work demonstrates possibility of mimicking biological ion channels using ligand induced nanopore structures.