Carbon Nanotubes Modified for Cellular Membrane Integration.

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Abstract

In this examination, we create a functionalized type of carbon nanotube with detergent molecules designed to integrate with cellular membranes via an attractive electrical force between our molecular construct and the membrane itself.

Upon examination, the functionality of our construct shows a bond between the carbon nanotube and the detergent molecules. Hopefully opening the door to more advanced studies of cellular interactions.

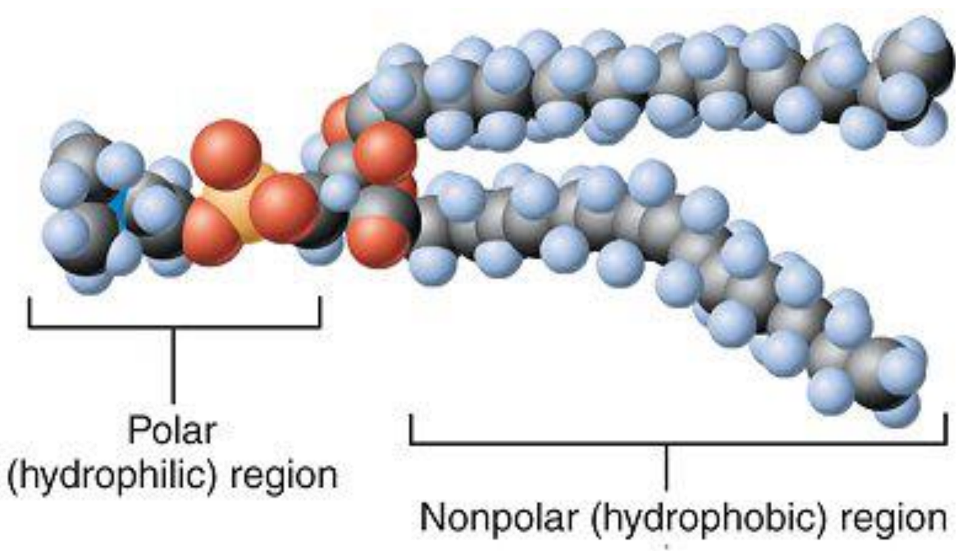


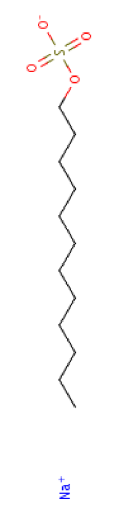
Figure 3, Phospholipid, From http://www.yellowtang.org/cells.php

Molecular Properties

Tween and SDS are molecules that have a charged 'head' and a long uncharged 'tail'. Just like the phospholipids which make up the cellular membrane of animal cells. However, these molecular heads are positively charged as opposed to phospholipid bilayers which are negatively charged at the head.

This makes them 'sticky' with respect to a cellular bilayer. However the substrate of a CNT prevent them from tearing the phopholipid bilayer of the cellular membrane apart.

This this could be useful in the creation of a connective molecular structure on the nanoscale such that individual cells, or parts of individual cells can be monitored for activity



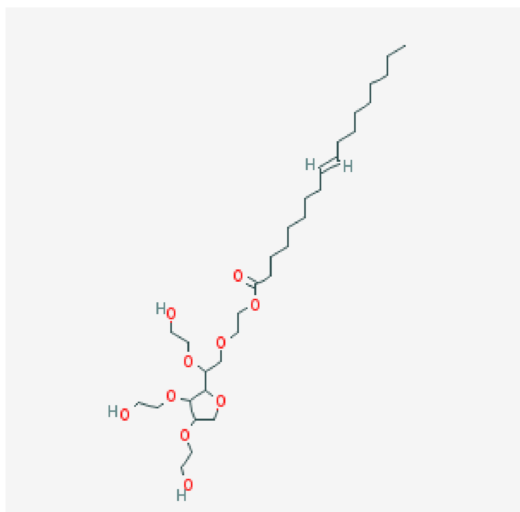


Figure 1, SDS
From sci-toys.com

Figure 2, Tween 80
From http://pubchem.ncbi.nlm.nih.gov/.

Introduction

Modern medicine has been exploring advanced methods of biological integration of circuitry and physiological constructs for some time. With goals of modifying the behavior of many different types of biological structures from individual proteins to entire cells via the introduction of foreign bodies.

However the integration of biological and non-biological systems has been extremely difficult. Non-biological systems either lack the capacity to properly interface with cellular systems, or they are damaging to the cellular systems with which they are integrated.

The goal of this examination is the creation of a biologically compatible, and highly conductive macromolecular construct. **In theory, we will modify, and functionalize carbon nanotubes such that they are no longer biologically incomparable through the addition of other molecules.** Modifying the properties of these carbon nanotubes will create the possibility of performing functions with them in the biological sciences.

Generally, a carbon nanotube (CNT) is hydrophobic, which prevents both water-dispersion in solution and is part of what prevents a CNT from interacting with a cell. Our method around this is the use of two detergent molecules, SDS, and TWEEN, [fig. 1] and [fig. 2]. By attaching these molecules, the hydrophobic / hydrophillic nature of the molecule will cause the hydrophobic end to face the CNT while the hydrophillic end will face away from the CNT. After fictionalization in acids, the CNT will have been partially dissolved and there will be available binding sites on the surface. Utilizing these binding sites, it is possible to bind the hydrophobic end of the detergent molecule to the wall of the CNT.

Functional result:

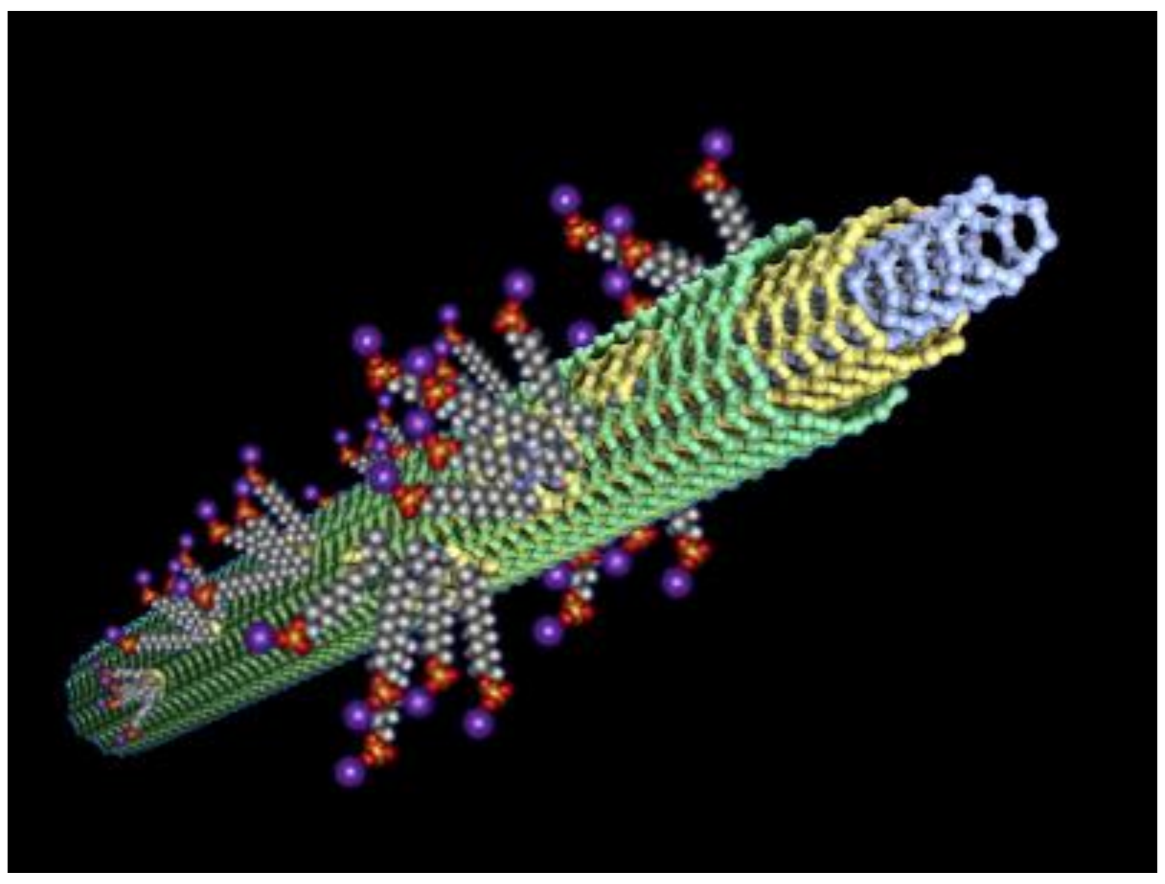


Figure 4. Functionalized Multiwall Carbon Nanotube with SDS.

Examination of Structure

Via observing the absorption spectra of the Tween 80 solution, it is possible to correct for all substances in their non-bound state. Any further spectra appearance are the result of molecular interaction and covalent bonding.
The spectra show an absorption peak at 300nm which is unaccounted for from other sources.

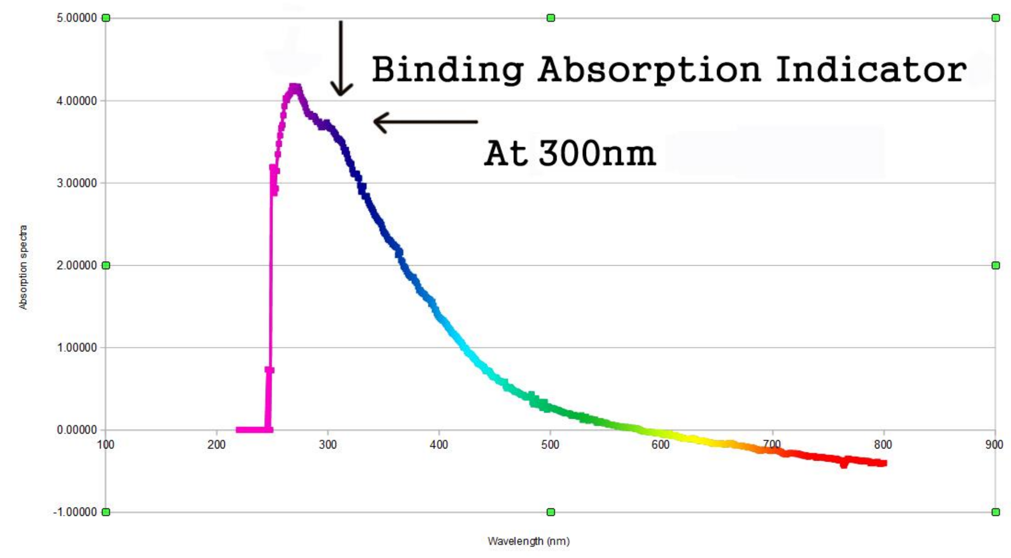


Figure 5. Correct absorption spectra

Discussion

The new spectral peak at 300nm indicates that there exists a change in material properties. The most likely cause of this occurrence is a covalent bond at the reactive binding sites which have been generated on the surface of the nanotube.
Using further analysis, it is now necessary to test the properties of the constructed nanotube as well as place it in an interactive media. A proper characterization of this structure should lead to potential uses in terms of analyzing cellular media and possible use in medical development.

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Citations;

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