Cationic Functionalization of Single-Walled Carbon Nanotubes for Cytoplasmic Delivery into Synechococcus Cyanobacteria

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Recently nanoparticles have gained a lot of interest and are significantly being used in many applications such as biosensing, bioimaging, and drug delivery. Nanoparticles are very versatile, modifiable, and robust research probes. Specifically, semiconducting single-walled carbon nanotubes (SWCNTs) have photostable near-infrared (NIR) fluorescence signals that respond to their local environment via modulations in wavelength and/or intensity. These qualities make it an easy and reliable tool for biosensing and bioimaging within living cells. However, investigations of NIR fluorescent SWCNTs interacting with bacteria remain largely unexplored. Therefore, this study aims to examine the interactions between SWCNTs and Cyanobacteria, i.e. a dominant photosynthetic, a bacteria responsible for harmful algal blooms. This was accomplished by inserting fluorescent SWCNTs functionalized with one of 3 different samples of amphiphilic polymers (e.g., GT15 DNA oligonucleotide, Lysozyme, and Chitosan, the latter two being cationic) into cyanobacteria. The methods for the study included using a Zetasizer instrument to measure the zeta potential (i.e. overall surface charge) of the three dispersed SWCNT samples. The interactions of SWCNTs and cyanobacteria were examined using NIR fluorescence microscopy to investigate the “spectral fingerprint” and localization of SWCNTs in the cyanobacteria at 3 different time points. We hypothesized that SWCNTs with a cationic functionalization will penetrate the multi-layer cell wall of the cyanobacteria, resulting in the SWCNTs entering the cytoplasm. Preliminary data suggest this hypothesis is true.

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