Functionalization Enhancement of Carbon Nanotubes for Bio-Assays

W. E. Kim, N. Kouklin and J.M. Xu
Division of Engineering, Brown University, Box D, Providence, RI 02912, USA; Email: Nickolai_Kouklin@brown.edu

Due to their molecular size, biocompatibility and cellular internalization properties, there has been increasing interest in using nanotubes in molecular cell biology and medical exploration. Although many potential applications have been suggested for CNTs in these areas, the fundamental problem of solubility and processability has been a major impediment to experimentation. Though there have been quite a few methods developed to address the problem of solubilization, there has been little work towards reducing the complexity and increasing the efficiency for making these solubulized nanotubes.

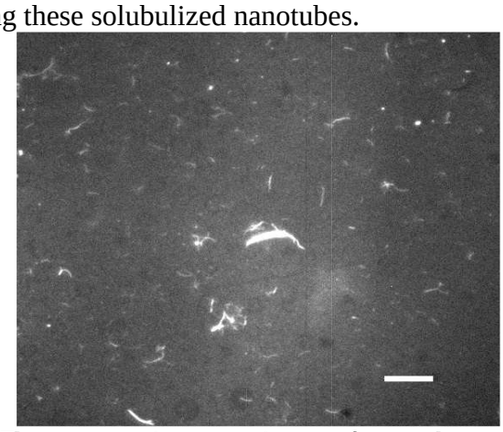

Fig 1. Fluorescent microscope image of nanotube made water soluble and uniformly conjugated with fluorescently labeled antibodies, scale bar is 10 μm

Nanotube solubilization has been realized through both covalent and noncovalent modifications of the sidewall and ends of these structures. In most of the biological applications we have identified, satisfactory solubilization can be achieved through a simple acid treatment and solvent extraction procedure we developed.

However, just as important is the ability to process these solubulized nanotubes in a practical manner. Given the minute quantities of purified biological material typically available to study a specific biological process, it becomes critical to be able to perform reactions that not only results in a high degree of *useful* conjugation but also enables the simple collection and purification of the reacted nanotubes.

With this in mind, we have developed and will report in this presentation a methodology that will enable the use of high concentrations of CNTs and purified biological materials which obviates the need for dilution (and thus retarding reaction rates) while simultaneously reducing the amount of non-productive crosslinking between nanotubes. In order to accomplish this, we exploit the solubility differences of our treated CNTs in various solvents (which we can insure using the solubilization technique mentioned above). We will show that this can best accomplished by the creation of unstable micelles which serve as reaction centers and also serves as recovery mechanism to facilitate the separation and collection of the reaction products.