Carbohydrate coating of carbon nanotubes for biological recognition

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Carbon nanotubes (CNTs) have been attracting considerable attention because of their unique physical properties and potential for a variety of applications. Modifications of CNTs by covalent and non-covalent methods have been examined in recent studies. However, no facile method for incorporating carbohydrate chains as recognition signaling molecules into a CNT has been reported. Here we describe a simple method for surface modification of a CNT with carbohydrate chains as recognition signaling molecules. In this study, we used commercially available lactose-carrying polystyrene (PVLA), which has both pendant β-galactose moieties for use as recognition signaling molecules and a polystyrene backbone that can be adsorbed onto the surface of a CNT via hydrophobic interactions.

The procedure used for coating a MWNT (n-MWNTs: from NanoLab, m-MWNTs: from MTR Co. Ltd.) with PVLA was as follows. FITC-labeled PVLA and MWNT material were put into water and ultrasonicated for 15 min. After 1 h of incubation at room temperature, the mixture was centrifuged. The aggregated MWCNT was carefully washed with PBS and deionized water to remove the unreacted polymer. Fluorescence observation by confocal laser scanning microscopy showed that the carbohydrate-carrying polymer was uniformly and densely localized along needle shape of the m-MWNT.

To evaluate biological recognition affinity, interactions of the MWNT with lectins were examined by binding tests. The resultant MWNT was found to acquire a selective binding affinity to the corresponding lectin without a nonspecific interaction. On the other hand, a bare MWNT nonspecifically interacted with lectins. These results showed that a MWNT coated with a carbohydrate-carrying polymer has biological recognition signals.

Modification of a CNT with various carbohydrate chains will be a useful protocol for molecular designs of biomaterials, nanoarchitecture, and biosensors.