Solubility of various aziridinyl-functionalized carbon nanotubes

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1 Introduction

Carbon nanotubes (CNTs) are nanomaterials with unique properties and they are potentially useful for many applications in electronics, nanotechnology, optics, architechture and materials science. Use of carbon nanotubes has some limitations. The solubility of pristine carbon nanotubes is very low in any solvent. This limitation can be overcome by a proper covalent or non-covalent functionalization [1]. Water-solubility is very useful property for CNTs. It may open access to many applications eg. printed electronics, tissue engineering or biomaterials [2]. Soluble carbon nanotubes have also been used to prepare chemical sensors, to detect various toxic gases, like Cl_2, NO_2, NH_3, HCN, CO or H_2S [3-6]. Reported strategies to improve the water-solubility of CNTs include an introduction of water-soluble functional groups to CNTs, such as carboxyl, hydroxyl or sulfonate groups [7]. Sugars are rich in hydroxyl groups and are therefore fascinating compounds for this purpose. Amide-linked, galactose- and mannose functionalized carbon nanotubes have shown to have selective interactions with *Bacillus subtilis* or *Bacillus anthracis* [8]. Bacillus spores (especially *Bacillus anthracis*) have been an ongoing research emphasis of the counter-bioterrorism community [9]. It is known that aggregated spores would cause significantly less or diminished threat in terms of the most lethal inhalation anthrax infection and that is why the aggregation of sphores could be useful to the ongoing effort on countering anthrax based bioterrorism [10,11].

2 Objectives of the research

The aim of this research was to study the solubility of some covalently functionalized single walled carbon nanotubes (SWCNTs) 1-6 useful for various applications. The chosen solvents were water, methanol, ethanol or dimethyl formamide (DMF). Water and ethanol are environmentally benign solvents. DMF and methanol were used, because they have strong solvating ability. The studied functionalized CNTs were prepared by reaction of nitrenes with carbon nanotubes [12].

3 Results

In this work, the solubility of six nitrogen bridged functionalized SWCNTs 1-6 were studied and compared. Some of the products showed solubility in water or DMF.

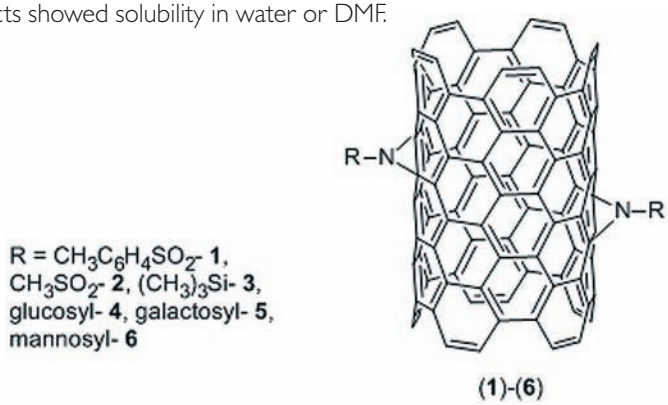

Figure 1 *Aziridinyl-functionalized carbon nanotubes 1-6 compared in solubility tests in water, alcohols or DMF.*

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4 Relevance of the research

Amide-linked, galactose- and mannose- functionalized carbon nanotubes have been reported to have selective interactions with *Bacillus subtilis* and *Bacillus anthracis*[8]. Bacillus spores (especially *Bacillus anthracis*) and their surface structures able to bind with bioactive species have been an ongoing research emphasis of the counter-bioterrorism community[9]. Soluble, functionalized carbon nanotubes have been used as chemical sensors. In this research, the solubility of various functionalized carbon nanotubes, possible candidates for applications, was studied.

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Reference to this article:

Leinonen H., Lajunen M. (2010) Solubility of various aziridinyl-functionalized carbon nanotubes.
In: Pongrácz E., Hyvärinen M., Pitkäaho S. and Keiski R. L. (eds.) Clean air research at the University of Oulu. Proceeding of the SkyPro conference, June 3rd, 2010, University of Oulu, Finland.
Kalevaprint, Oulu, ISBN 978-951-42-6199-2. pp.106-107.

SkyPro conference: http://nortech.oulu.fi/SkyPro/index.html

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