NON-COVALENT FUNCTIONALIZATION OF CARBON NANOTUBES WITH GLYCOLIPIDS: GLYCONANOMATERIALS WITH SPECIFIC LECTIN-AFFINITY

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The utilization of a nanomaterial wrapped in biologically relevant molecules to study and solve biomedical problems is a new and stimulating field of research.[1] One of the most salient features of using nanomaterials, such as nanoparticles, nanorods, nanowires and carbon nanotubes in biology is their ability to carry multiple copies of a single drug or various active principles with different, ideally synergistic, modes of action.[2] Consequently, those diseases or biological processes whose biological targets require a multivalent display of the active epitope, are expected to benefit from the application of a nanometric platform. Illustrative examples of such events are those mediated by carbohydrates, which include cell adhesion, inflammation, tumour cell metastasis, and pathogen infections.[3] It has been shown that the weak interaction between an individual ligand and the corresponding specific lectin is compensated by the multivalent display of carbohydrates through the so called cluster effect.[4] On the other hand, single-walled carbon nanotubes (SWCNTs) as interesting 1D nanomaterials, are actually being actively investigated as vehicles for the in vivo smart delivery of biologically relevant cargoes including drugs, proteins, and nucleic acids, as nanometric sensors, and for cancer treatment.[5]

In this study, we disclose our results on the utilization of carbon nanotubes as molecular platforms for a multivalent presentation of biologically relevant saccharide epitopes. Our strategy is based on the utilization of neutral pyrene functionalized neoglycolipids **I** [6] that interact with a CNT's surface giving rise to a nanometric material with a multivalent display of carbohydrates, much like the glycocalyx on the cell surface.[7]

The characterization of SWCNT-Py-PEG-Lac-**5**/Py-PEG-Man-**6** as well as MWCNT-Py-PEG-Lac-**5**/Py-PEG-Man-**6** aggregates is carried out by transmission electron microscopy (TEM).

In order to study this specific binding feature, critical for future biological applications of the prepared bio-nanomaterials, we make use of the known sugar-lectin specificity.[8]

In summary, we have developed a mild and practical non covalent approach for the functionalization of carbon nanotubes. The obtained aggregates with a multivalent sugar exposition on their surface are able to engage specific ligand-lectin interactions similar to glycoconjugates on the cell membrane.

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Figures: