Title	Synthesis, processing, and implementation of water-dispersible multi- and single-walled carbon nanotubes for electronic devices

Proponent	Stefano Casalini
Research Group	Surface supramolecular chemistry (SSC) group
Contact	web: https://sites.google.com/view/surface supramolecular-padua/home
	email: stefano.casalini@unipd.it
Co-Proponent	Enzo Menna
Research Group	Organic synthesis and materials group
Contact	web: https://wwwdisc.chimica.unipd.it/lab205/pubblica/
	email: enzo.menna@unipd.it

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PI	Prof. Paolo Samorì
Institute	Université de Strasbourg, Institut de Science et d'Ingénierie Supramoléculaires
Place, country	Strasbourg, France
# months (min.3)	6

Project description (2 page max):

Nowadays, low-dimensional materials are gaining great attention in the scientific community due to their unique properties, such as optoelectronic features, outstanding aspect ratio, lightweight, chemical versatility etc. [1]

This PhD thesis is focused on the extensive use of single and multi-walled carbon nanotubes (SWCNTs and MWCNTs, correspondingly), whose backbone has been properly modified to make them easily dispersible in aqueous solution (WD-SWCNTs and WD-MWCNTs).[2] For instance, organic syntheses are already under investigation to modify the surface of such CNTs by adding hydrophilic moieties like sulfonates, amines etc. These pendant groups do not only turn a hydrophobic pristine CNT into a hydrophilic one, but they also allow further chemical changes, which can confer additional functionalities as pollutant harvesting, host-guest pairing etc.

Among the relevant features of WD-SWCNTs and WD-MWCNTs, one of particular interest is the capability to transport charge carriers. As a result, it is well established that MWCNTs feature a metallic behaviour, on the contrary SWCNTs with specific structures show a semiconducting one.[3] For this reason, such materials are already a matter of study in electronics as active materials in different devices such as supercapacitors, transistors, resistors etc.[4]

Here, the project aims at developing well-suited hybrid materials based on either WD-SWCNTs or WD-MWCNTs as fillers, in a biocompatible matrix such as alginate, polyvinyl alcohol, poly lactic-co-glycolic acid. These smart scaffolds are a matter of investigation towards nerve/tissue repair.[5] The resulting materials will be processed to obtain relevant components in electronics such as resistors, primers for electrodes and active materials for electrolyte-gated transistors (EGTs).[6]

References

[1] Y.K. Paras et al. A Review on Low-Dimensional Nanomaterials: Nanofabrication, Characterization and Applications, 2023, Nanomaterials, 13, 160.

[2] P. Salice et al. "An insight into the functionalisation of carbon nanotubes by diazonium chemistry: Towards a controlled decoration", 2014, Carbon, 74, 73-82.

[3] M.S. Dresselhaus et al. "Physical Properties of Multi-wall Nanotubes. In Carbon Nanotubes: Synthesis, Structure, Properties, and Applications" Eds.; Springer Berlin Heidelberg: Berlin, Heidelberg, 2001; pp. 329-391

[4] R. Maheswaran et al. "A Critical Review of the Role of Carbon Nanotubes in the Progress of Next‐Generation Electronic Applications" 2022, Journal of Electronic Materials, 51, 2786-2800

[5] G. Cellot et al. "Carbon nanotubes might improve neuronal performance by favouring electrical shortcuts", 2008, Nature Nanotechnology, 4, 126-133.

[6] B. Shkodra et al. "Electrolyte-gated carbon nanotube field-effect transistor-based biosensors: Principles and applications", 2021, Applied Physics Reviews, 8, 041325.