UNIVERSITA' DEGLI STUDI DI PADOVA
Dipartimento di Scienze Chimiche

Functionalization of SINGLE WALL CARBON NANOTUBES with poly(ethylene glycol)

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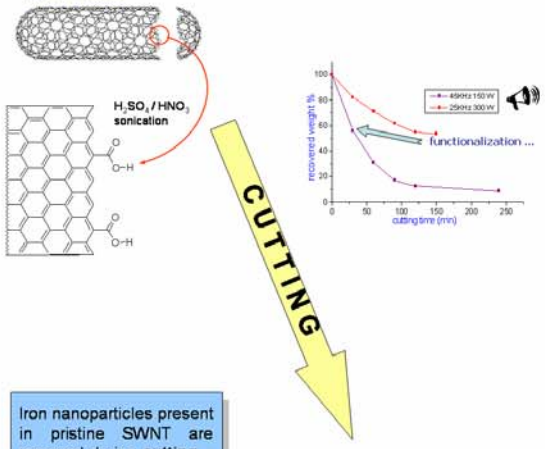
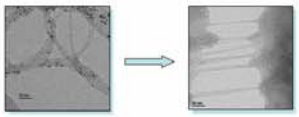
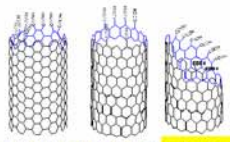
HiPco tubes



Iron nanoparticles present in pristine SWNT are removed during **cutting – etching** process.



HR-TEM



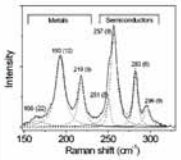
shortened SWNT **(sh-SWNT)**

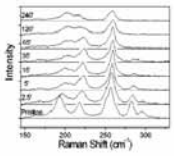
Collaboration with Stefano Polizzi (University of Venezia)

A procedure for the cutting of nanotubes developed by Smalley and coworkers produces small pipes called sh-SWNT (i.e. shortened SWNT). It consists of prolonged sonication in a concentrated H_2SO_4 / HNO_3 mixture followed by an etching process in a H_2SO_4 / H_2O_2 mixture (*piraña solution*) to remove amorphous carbon particles and small fragments.
Resulting sh-SWNT bears carboxylic groups at the ends, that are then activated as acyl-chloride groups by treatment with thionyl chloride. Acylated tubes are then coupled via amide bond with PEG chains bearing an amine group.

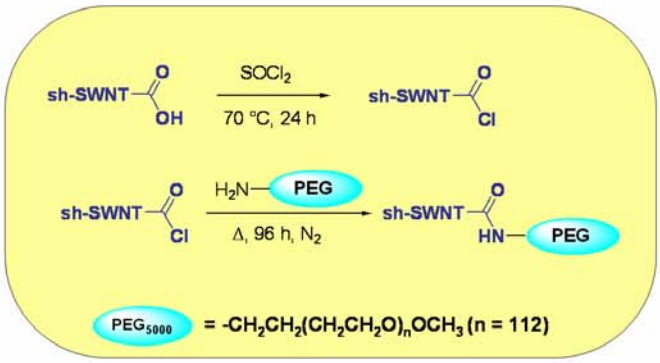
Selectivity of CUTTING process

The analysis of the radial breathing mode makes it possible to assign the observed bands to metallic and semiconducting SWNTs and to suggest the chiral indices. Small diameter tubes, due to the stress induced by the curvature, are first attacked and destroyed.



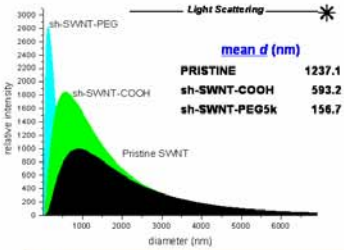


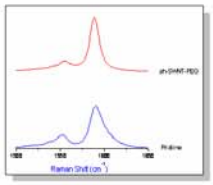
Soluble up to 5 mg/ml
($CHCl_3$, THF ...)



sh-SWNT-PEG

Disentanglement

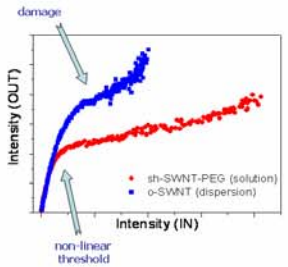




Functionalization prevents aggregation of SWNT in solution: *laser scattering* shows smaller clusters, and Raman band at 1591 cm^{-1} decreases from 18 to 11 cm^{-1} (single SWNT: 9 cm^{-1}).

Optical limiting

Functionalization provide to SWNT a lower non-linear threshold and a higher damage threshold.



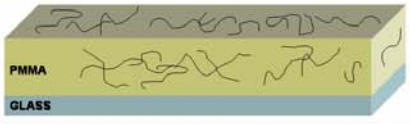
Supporting on silica gel

Soluble SWNT derivatives have been adsorbed on the surface of spherical particles of silica gel (d = 100 – 5000 nm) for the realization of HPLC stationary phases.

Collaboration with Claudio Villani (University of Roma "La Sapienza")

Embedding in polymer films

sh-SWNT-PEG have been embedded in polymethylmethacrylate films (thanks are due to Gabriele Marcolongo) cast on glass cover slips, allowing photophysical studies in dispersed solid phase.
In particular, pump-probe experiments with femtoseconds time resolution have been performed.



Collaboration with Guglielmo Lanzani (Politecnico di Milano)

See posters **XVI.10** and **XVI.14** by **G. Lanzani** *et al.*

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