

# n-type doping nanotubes by encapsulation of conjugated oligomers

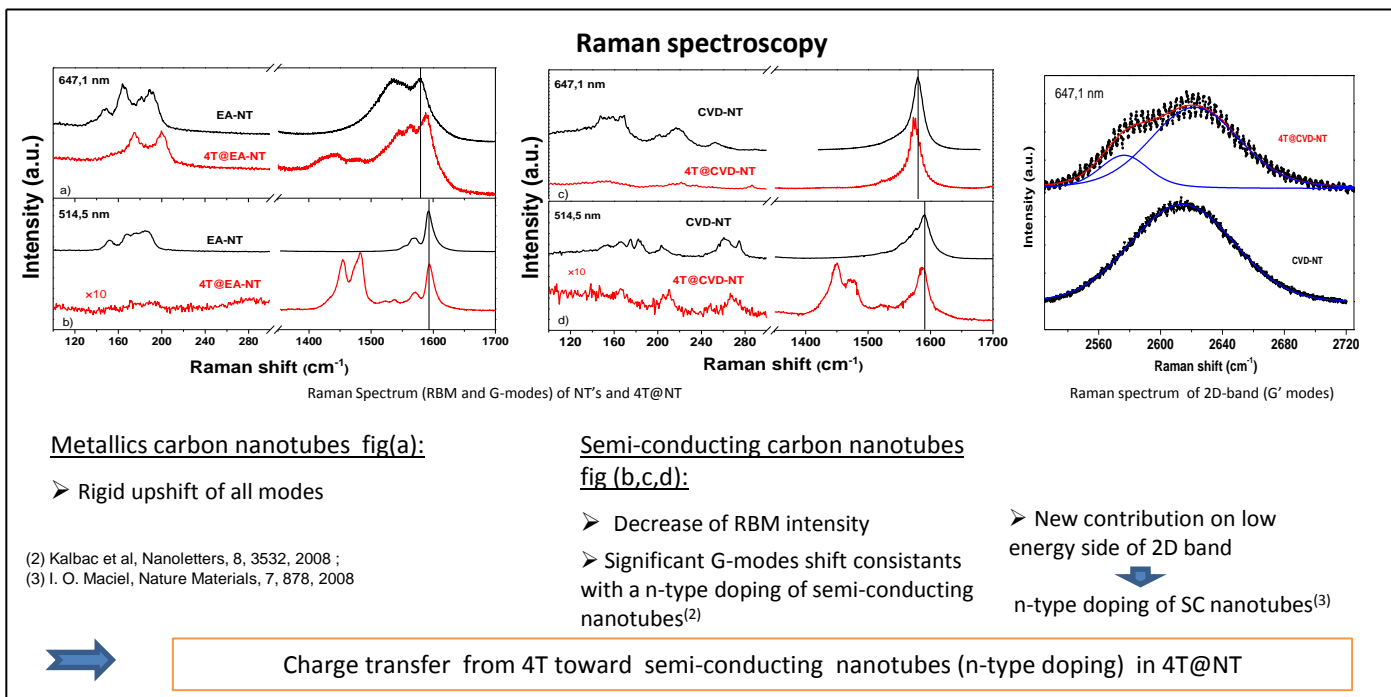
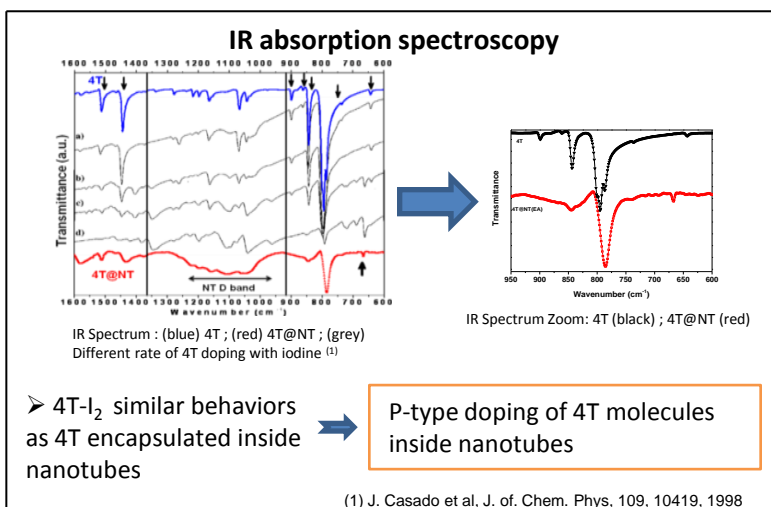
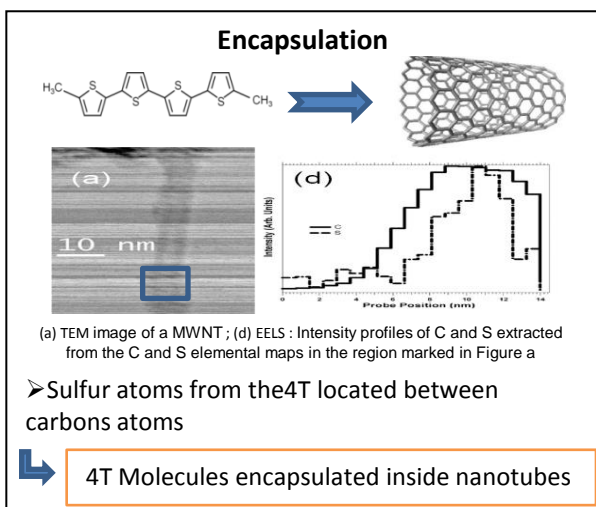


Y. Almadori<sup>(1,2)</sup>, L. Alvarez<sup>(1,2)</sup>, R. Arena<sup>(3)</sup>, R. Babaa<sup>(4,5)</sup>, T. Michel<sup>(1,2)</sup>, R. Le Parc<sup>(1,2)</sup>, J.-L. Bantignies<sup>(1,2)</sup>, B. Joussemle<sup>(5)</sup>, S. Palacin<sup>(5)</sup>, P. Hermet<sup>(1,2)</sup> and J.-L. Sauvajoil<sup>(1,2)</sup>



- (1) Université Montpellier 2, Laboratoire Charles Coulomb UMR 5221, F-34095, Montpellier, France
- (2) CNRS, Laboratoire Charles Coulomb UMR 5221, F-34095, Montpellier, France
- (3) Laboratoire d'Etude des Microstructures, CNRS-ONERA, 92322 Chatillon, France
- (4) Chemical Engineering Department, University of Technology PETRONAS, (UTP), Ipoh-Perak, Malaysia
- (5) CEA, IRAMIS, SPCS, Laboratoire de Chimie des Surfaces et Interfaces, 91191 Gif-sur-Yvette Cedex, France

**Motivations :** Hybrid system (4T@NT) consisting in oligomer (quaterthiophene derivative) inserted into single and multi-walled carbon nanotubes is studied. Such hybrid system can display new and fascinating physical properties. They can play a crucial role for electronic and optoelectronic applications. Such oligomer have for example significant potential for competition with silicon in the photovoltaic devices, and it seems that carbon nanotubes can act as a good protection to increase the stability and the life time of these molecules.



## Conclusion

We first found out, by means of Raman spectroscopy, a very weak interaction when 4T are inserted into metallic nanotubes. By contrast, a significant charge transfer has been evidenced with semiconducting tubes. Thus, a detailed analysis of the Raman G and the 2D bands before and after the oligomer insertion inside nanotubes suggests a n-type doping of the semiconducting nanotubes. Finally, IR spectrum suggests a p-type doping of the oligomers trapped into nanotubes. In conclusion, both Raman and IR results are consistent with electron charge transfer from 4T molecules to semiconducting nanotubes in 4T@NT samples.