

Transistors based on graphene or double wall carbon nanotube hybrids for optoelectronics

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Abstract

Carbon nanotubes (CNTs) are ideal platforms for realizing new functional devices such as ultrasensitive gas detectors, molecular scale logics and quantum devices, due to their outstanding electrical properties. Particularly, double walled nanotubes (DWNTs) consisting of two concentric single walled CNTs, can be treated as structures of two twisted and stretched graphene bilayers that exhibit complicated but relatively independent electronic properties, visible using molecule grafting on the outer wall [1].

Photo active molecules such as porphyrin molecules and osmium terpyridine complex have the ability to reversibly switch between two or more stable states in response to external stimuli such as light, temperature or an electrical current, and can thus find application in molecular electronics [2]. A few studies have already demonstrated the efficient photo induced charge transfer in CNT/porphyrin hybrid systems by using electrochemical methods, photoluminescence excitation experiments [3] as well as absorption spectra.

Here we use Raman spectroscopy as a powerful tool both for the investigation of isolated DWNT and graphene and to study the charge transfer between the chemical dopants and DWNT or graphene. We demonstrate transistors based on isolated DWNT (or graphene) and photo active molecules probed with combined Raman spectroscopy and electrical transport measurements. The role of light in the control of the state of the hybrid will be manifested and elucidated in terms of photo-induced charge transfer.

References

[1] D. Bouilly, et al. ACS nano **5**, (2011), pp. 4927-4934.

[2] C. B. Winkelmann, et al. Nano lett. **7** (2007), pp. 1454-1458.

[3] F. Violla, et al. Phys. Rev. Lett. **111** (2013), pp.137402

Figures

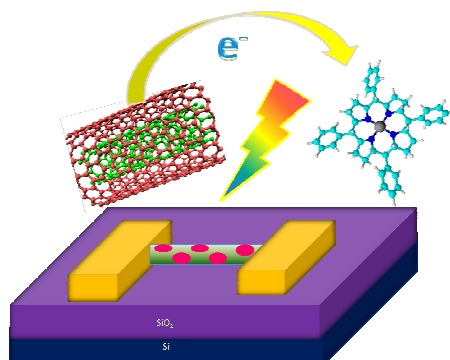


Figure :Principle of the chromophore-DWNT transistors. The molecule is deposited on chip on the transistor. Light excitation of the chromophore acts as an optical gate.