ELECTRONIC TRANSPORT PROPERTIES OF ION IRRADIATED SINGLE WALLED CARBON NANOTUBES

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Electronic transport in carbon nanotubes has been a field of intensive research in the last years. Up to date most of the works have been focused on the defect-free nanotubes, but defects are known to modify the electronic properties of carbon nanotubes. In this work we report direct evidences of the influence of artificially induced defects, on the electronic quantum transport in single walled carbon nanotubes. Defects are induced in single walled carbon nanotubes by Ar^+ ionic bombardment. Consecutive ion irradiation doses are applied to nanotubes producing a uniform density of defects. After each dose the electrical characteristics of the same carbon nanotube are measured by using a conductive atomic force microscopy. Using this method we are able to measure the resistance *vs*. Length characteristic of the nanotube [1] after each known dose of Ar^+ ions. The results are fitted to $R(L)= R_C+R_0/2\cdot\exp(L/ L_0)$ indicating electronic transport in the Anderson localization regime. The data present a decrease of L_0 with increasing doses of irradiation. According to ref [2] irradiation with low energy Ar^+ ions mainly creates mono and di-vacancies in SWNTs. We have used a first-principles Local Orbital Density Functional method and standard Green-function techniques to study the effects of mono and di-vacancies in the electronic transport properties of metallic SWNTs. Calculations show that mainly di-vacancies contribute to the experimental increase in resistance. Theoretical results for metallic nanotubes with a random configuration of di-vacancies also predict an exponential increase of the resistance vs. length. This allows easy comparison between theory and experiments. We conclude that only a 0.03% of di-vacancies produce an increment of three orders of magnitude in the resistance of a 400 nm carbon nanotube segment. This provides for the first time a quantitative experimental study of the influence of defects in the electronic transport properties of SWNT.

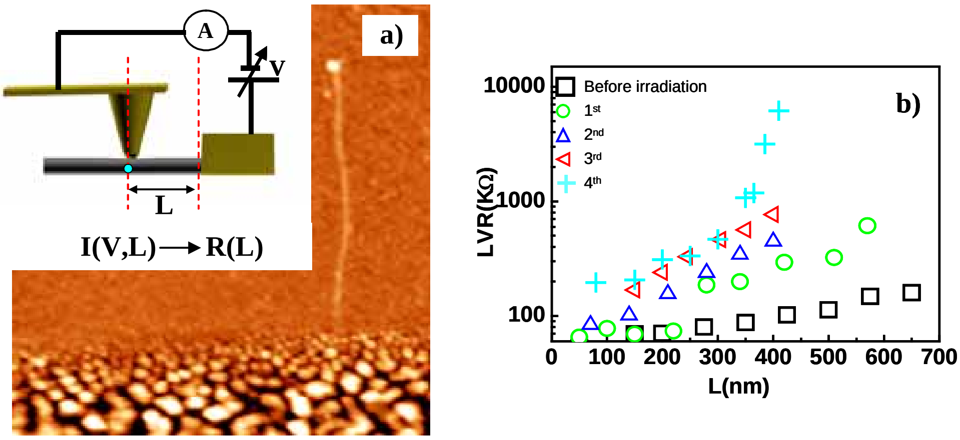

Figure a) AFM image of a single-walled carbon nanotube partially covered by a gold electrode. The inset in figure a) shows a scheme of the experimental set-up used to make the measurements. Figure b) is a plot of five resistance vs. length curves obtained for a nanotube before irradiation and after four consecutive irradiation doses with Ar^+ ions.

References

[1] de Pablo, P. J. et al. *Physical Review Letters* **88**, 36804-36808 (2002).
[2] Krasheninnikov, et al. *Physical Review B* **6324**, 245405 (2001).