TUNING THE CONDUCTANCE OF SINGLE WALLED CARBON NANOTUBES BY ION IRRADIATION IN THE ANDERSON LOCALIZATION REGIME

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Defects are known to modify the electrical resistance of carbon nanotubes .They can be present in as-grown carbon nanotubes , but controlling externally their density opens a path towards the tuning of the nanotube electronic characteristics. In this work consecutive Ar^+ irradiation doses are applied to single-walled nanotubes (SWNTs) producing a uniform density of defects. After each dose, the room temperature resistance versus SWNT-length dependence (R(L)) along the nanotube is measured by using atomic force microscopy (AFM). Our data show an exponential dependence of R(L) indicating that the system is in strong Anderson localization regime. Simulations demonstrate that mainly di-vacancies contribute to the resistance increase induced by irradiation. By comparing experiments and theory, we conclude that 1 out of 4 Ar^+ ions creates one di-vacancy and that a 0.03% of di-vacancies produces an increase of three orders of magnitude in the resistance of a 400 nm SWNT length. The theoretical calculations also predict a linear dependence of the localization length with the distance between di-vancies, in good agreement with the experimental data. The present results are relevant for the performance of nanotube-based sensor devices.