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HIGH-CURRENT

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Due to their unique mechanical, electrical and chemical properties, carbon nanotubes (CNTs), particularly single walled (SWCNTs), represent exciting opportunities for fundamental science and new technologies. The integration of CNTs into nano-electronic devices essentially requires the ability to control CNT growth in terms of diameter and chirality, since their electronic properties are determined by the nanotubes structure. The aim of this work is the study of SWCNs growth using the hot filament enhanced chemical vapor deposition (HF-CVD) process. The originality of this study lies in the preparation of the catalyst. At first the growth substrate is functionalized by silanization, leading to the formation of a pyridine terminated molecular monolayer. Self assembled monolayers of metallic complexes such as Ru tetraphenyl porphyrins (RuTPP) are then obtained by coordination between the metal ions and the pyridine groups pointing out from the surface. Exposing these catalysts containing monolayer to the HF-CVD conditions lead to the formation of SWCNTs. The method allows to control the size and the surface density of the catalytic metallic nanoparticules formed through a subsequently annealing step. In conjunction with a proper selection of synthesis parameters this can further allow some control on the SWCNTs diameters, their surface density and eventually to a certain selectivity of their chirality. In this work, the effect of HF-CVD synthesis parameters, such as growth temperature, CH4 concentration and growth time on the formation of the SWCNTs were studied using CH4/H2 over a Ru catalyst. The morphologies of the CNTs on Si substrates were characterized by atomic force microscopy (AFM), scanning electron microscopy (SEM) and micro-Raman spectroscopy. The results show the formation of SWCNTs with diameters ranging from 1 to 2 nm, with a controlled surface density and very good transport characteristics. The electrical results show the realisation of transistors with high value of on/off (107).