PO4063

On the role of supporting material and catalyst for growth of carbon nanotubes in microwave torch

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Various possible applications of carbon nanotubes (CNTs) require different types of substrates and catalysts. The surface-bound CNTs, tested for different types of sensors, were prepared in the microwave (mw) plasma torch (2.45 GHz) from the mixture of CH4/H2/Ar or C2H2/H2/Ar on different substrates with iron or nickel catalysts. The bulk substrates were either polished silicon (Si) or alumina ceramic. The polished Si substrates were treated by thin film technologies in order to prepare required sensor structures and catalysts for CNTs growth. The growth of CNTs using vacuum-evaporated iron thin film was tested for direct contact between grown CNTs and conductive Si. Deposition under optimized conditions yielded in dense forest of multi-walled nanotubes (MWNTs), similar as when silicon oxide buffer layer was used between Si and iron catalyst. Further experiments included studies of CNTs growth and disintegration of iron film for several different supporting materials, especially thermally grown silicon dioxide, plasmachemical deposited SiOx or organosilicon films, oxidized vacuum-evaporated aluminum films (AlxOy) and vacuum-evaporated gold contacts. It was not possible to grow CNTs on gold material but other supporting materials allowed rapid growth of MWNTs with varying density, purity and diameter distribution. Alternatively, the catalyst was prepared in the form of iron oxide nanoparticles on Si/SiOx substrates by decomposition of Fe(CO)5 vapors directly in the mw torch. The alumina ceramic was used for preparation of sensor structures using thick film technologies, namely screen-printing technique. The CNTs were grown on contacts made of Au, Ag or Pt-based conductive pastes covered by iron or nickel catalysts.

Keywords
CNT
carbon nanotubes
PECVD