CONTROLLING SYNTHESIS OF CARBON NANOSTRUCTURES BY PLASMA MEANS IN ARC DISCHARGE

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Properties of single wall carbon nanotubes (SWNTs) are determined to large extent by synthesis techniques. Great interest in arc discharge production of SWNTs has been stimulated by its high practical utilization. While numerous studies of thermal stability of SWNTs were carried out, it is still under the question what is the critical temperatures that SWNTs can survive. At the same time thermal stability of SWNTs at conditions of atmospheric arc is crucial for determination of region of their synthesis in arc and in general for clarification of the thermal regime of SWNT in arc plasmas. We investigated electrical resistance dependence on temperature of mats of SWNTs under variable pressures in helium atmosphere, in the air and in vacuum in high temperature ranges (300-1200K) which closely mimic conditions during the synthesis in arc discharge. Dependence of SWNT resistance on temperature exhibits similar “V-shape” behavior for all applied conditions which characterized by two temperatures, namely T_{min} - temperature corresponding to the minimum of resistance and T_{cr} - temperature of destruction of SWNT bundles. It is found that T_{min} and T_{cr} in vacuum were 800 K and 900 K respectively and increased with helium pressure. T_{cr} increased faster with pressure than T_{min}, so that at 500 Torr T_{cr} was around 1100K, while T_{min} -900 K. This is the temperature that corresponds to buffer region between the arc plasma and helium background in arc discharge. Based on that it can be suggested that region of formation of SWNTs in arc should be close to arc periphery. Our study also demonstrates a strong effect of electric and magnetic fields on properties and growth conditions of SWNTs and other carbon nanostructures such as graphene. These effects are quantified by variety of diagnostics tools such as SEM, TEM, AFM - microcopies, TGA, RAMAN and UV-vis-NIR.