Iijima’s report in 1991 regarding carbon nanotubes and Novoselov’s report in 2004 about graphene stimulated a deluge of interests and progresses in carbon nanostructures research. To synthesize these kinds of nanoscale materials, arc discharge by erosion of graphite anode is considered as one of the most practical and efficient methods, which has great advantage to obtain product in better structure quality due to relatively high synthesis temperature and eco-friendly growth mechanism.

In this paper a comprehensive study of synthesis of single-walled carbon nanotubes (SWCNT) and graphene is demonstrated in experimental design and numerical simulation upon different growth parameters. By introducing a non-uniform magnetic field with the component normal to arc current flux, high-purity SWCNT and large-scale graphene flakes can be obtained in one step with the tendency to grow in different regions. In order to understand the growth processes thoroughly, in situ analysis of UV-Visible spectrum in arc is carried out to provide a unique investigation of transformation processes of various species in arc. Furthermore, a self-consistent numerical model is developed to simulate arc current, species density and temperature distribution inside arc chamber. Good agreements are observed between experiment and simulation results regarding distribution of particle diameters and so on. The morphology and quality of carbon nanostructures are characterized by SEM, TEM, EDX, Raman, UV-Vis-NIR absorbance and fluorescence spectroscopy.

* Work supported by NSF/DOE Partnership in Plasma Science and Technology, USA (NSF grant CBET-0853777, DOE grant DE-SC0001169)