PLASMA TECHNOLOGIES FOR SYNTHESIS OF CARBON NANOTUBES AND IRON OXIDE NANOPARTICLES

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Abstract

In many applications, plasma processing of materials appears to be an advantageous alternative to conventional chemical methods because it offers effective and environmentally friendly method for processing of materials. In this work, the surface bound deposition of carbon nanotubes (CNTs) and volume synthesis of iron oxide nanoparticles (NPs) was explored using microwave (MW) plasma torch. The torch is a laboratory plasma discharge that operates at atmospheric pressure and its gas temperature reaches several thousands of degrees. Therefore, it is a different plasma environment compared to other atmospheric pressure discharges used for plasma processing of materials, barrier discharges and cold plasma jets. The CNTs deposition from Ar/CH4/H2 mixture was studied with respect to the process of CNTs catalysis on different substrates and as electrode for electrochemical sensors. The effect of underlaying material was investigated for bare silicon, silicon oxide barrier layer and gold contacts. Tens of micrometer long multiwall nanotubes could be deposited on bare conductive silicon substrates. Synthesis of iron oxide NPs was accomplished from Fe(CO)5 vapors mixed with Ar and optionally O2. High purity maghemite NPs were obtained at optimized conditions. At high oxygen flow rates the synthesized mixture of NPs contained also epsilon-Fe2O3 that has unique magnetic properties. Spatially resolved OES of the mw torch was performed in various conditions of synthesis. The torch was imaged by a fast ICCD camera that visualized its dynamics and stability.

Keywords: microwave torch, CNTs, iron oxides

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