

INVESTIGATION OF SIZE-TUNABLE NON-CATALYTIC CARBON SPHERES BY VARYING GROWTH PARAMETERS IN CHEMICAL VAPOR DEPOSITION

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Carbon is a unique, life-forming element that can create various structures. These structures obtained from carbon have gained popularity in the scientific field due to their remarkable properties. Among them, the carbon sphere (CS) is a synthetically formed carbon structure that has attracted recent attention due to its applications in energy-storing devices, adsorption, and nanocomposites. In this study, NCS (Non-catalytic Carbon Spheres) in size range of 0.2-1.4 μm were produced *via* Chemical Vapor Deposition (CVD) through pyrolysis of acetylene in a nitrogen atmosphere. The effect of collector material in CVD, reaction time (30 – 90 min), deposition temperature (800 – 1100 $^{\circ}\text{C}$), and precursor mass flow rate (at the constant ratio of $\text{C}_2\text{H}_2/\text{N}_2$) on the morphology (diameter) of the NCS produced using CVD was investigated. The characterization of the as-synthesized NCS was done through Scanning Electron Microscopy (SEM), Raman Spectroscopy, X-ray Diffraction (XRD), and Fourier Transform Infrared Spectroscopy (FTIR). SEM results showed that the size of the NCS particles depends on the reaction time and temperature but not on the mass flow rates of the precursor gasses at a constant ratio. The collector material in CVD showed a substantial effect on the size of the spheres, possibly due to the surface roughness of the substrates and the differences in the nucleation rates. The NCS with the lowest dimensions (~364 nm) of uniform sphericity were collected from the thermal blocks of the CVD. The XRD and Raman spectroscopy results of the NCS grown on the thermal block showed the characteristic graphitic peaks of the carbon structures, which confirmed the existence of graphitized hexagonal carbon networks. FTIR analysis of the NCS indicated that their surface consists of hydroxyl, carbonyl, and carboxylic functional groups. The presence of these groups in NCS would be an advantage when using them for their potential applications.

Financial assistance from the National Research Council (Grant No 16-015) is acknowledged.

Keywords: Chemical Vapor Deposition (CVD), Non-catalytic Carbon spheres (NCS), Reaction time, Temperature, Thermal Block