Effect of Feed and Reaction Conditions on Surface Dimensions and Thermal Properties of High Aspect Ratio Carbon Nanotubes (CNTs)

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Abstract

CNTs have distinguish thermal properties, having high thermal conductivities compared to other metals and metal oxide nanoparticles. These thermal properties can further be improved by improving surface properties of the CNTs, which are highly effect by the CNTs synthesis conditions. In this study a three stage CVD reactor fitted with an ultrasonic atomization feeding system was used to synthesis lengthy high aspect ratio CNTs from a liquid vaporized mixture of p-Xylene and ferrocene in the presence of H_2 as a reduction gas. The small size of the vaporized feed droplets, the reaction temperature and the H_2 concentration, all effected the aspect ratio distribution. The surface morphology of the produced CNTs were characterize by BET, SEM and TEM. These high aspect ratio CNTs were further used as nanoparticles to prepare nanonfluids. The thermal conductivity and the heat capacity of these nanofluids were measured under static conditions. The results showed that the introduction of CNTs to water boosted both thermal properties of the nanofluid with an acceptable viscosity increase. Preliminary calculations on a lab double pipe heat exchanger, gave some insight into the effect of the nanofluid properties on pressure drop and heat transfer rates. This study shows that a comprehensive approach starting with the synthesis of nanoparticles with specific surface morphology is required to enhance heat transfer using nanofluids. This enhancement was illustrated in a qualitative manner in the present part of the study; however, more quantitative depth will be reported after running actual experiments in the double pipe heat exchanger.