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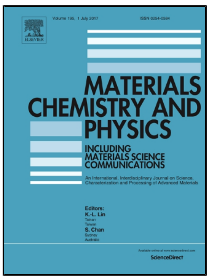

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Morphology and growth of carbon nanotubes catalytically synthesised by premixed hydrocarbon-rich flames

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Abstract

Synthesis of carbon nanotubes (CNTs) was performed by using a laminar premixed flame burner at open atmospheric condition. The growth of CNTs on the substrate was supported catalytically by a transition metal under high temperature, hydrocarbon-rich environment. Analysis of the CNTs using high resolution electron microscope reveals the structure of synthesised nano-materials in disarray, clustered and tubular form. The graphitic structure of the CNTs are rather similar for all fuel-rich equivalence ratios tested, with an average diameter of ~11-13 nm. Removal of the amorphous carbon and catalyst in the CNTs was performed via purification treatment using H_2O_2 and HCl solutions. Detail characterisation indicates the oxidation temperature of purified CNTs ranges between 497-529 °C. Deconvolution of the Raman spectra in the range of 900-1800 cm^{-1} shows the distinct characteristic bands of CNTs with I_G/I_D ratio of 0.66-0.72 for all the samples tested. In addition, the high level carbon concentration and sp^2 C-C bond in the CNTs is shown by X-ray photoelectron spectroscopy analysis. The present study demonstrates that CNTs can be effectively synthesised from fuel-rich hydrocarbon flames at ϕ=1.8-2.0 supported by nickel-based substrate.

Keywords: Carbon nanotubes, flame synthesis, Raman spectroscopy, TEM, CNT morphology, XPS

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