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Single-step synthesis of graphene-carbon nanofiber hybrid material and its synergistic magnetic behaviour

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Abstract: Graphene-carbon nanofiber (CNF) hybrid materials were synthesized by a simple one-step chemical vapor deposition method using propane over a $Co_{63}Ni_{37}$ alloy catalyst supported on a silicon substrate at 800 ºC. The process involves catalyst de-wetting, carbon diffusion and precipitation, with the additional carbon being provided by the polymer (photo-resist, HPR-504). The formation of a graphene-CNF hybrid structure was observed in the presence of the polymer. The polymer plays a crucial role in the formation of the flat carbon nanostructures. In the absence of the polymer, only carbon nanotube growth was observed with the same catalyst under identical experimental conditions. The effect of the polymeric photo-resist layer on the growth of the hybrid structure was analyzed. Structural and morphological data in combination with the Raman spectroscopic data confirmed the formation of a few layers of highly crystalline graphene and CNFs in a hybrid structure. The magnetic behavior of these as-grown graphene-CNF hybrid samples has been analyzed by using a superconducting quantum interference device (SQUID). The results from the magnetic measurements on these samples have also been discussed.

Keywords: Nanostructured materials; chemical synthesis; vapour deposition; catalysis; magnetic measurements; microstructure

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