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One-Step Fabrication of N-doped CNTs Encapsulating M nanoparticles (M=Fe, Co, Ni) for Efficient Microwave Absorption

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Abstract

By using a modified non-toxic pyrolysis method, M@NCNTs comprising in-situ formed M nanoparticles encapsulated in nitrogen-doped carbon nanotubes (NCNTs) have been synthesized. Compared to traditional preparation process of M@CNTs (*eg.*: acid-aid treatment to CNTs then decorating M particles onto), this method holds the advantage of free of complicated treatment processes. The M@NCNTs exhibit tightly connected interfaces of M/NCNTs and contain abundant N dopants, which could contribute interfacial polarization and defect-dipole polarization to improving the microwave absorption performance. An intense dielectric relaxation is observed in Fe@NCNTs samples, which further enhances the dielectric loss. As expected, the as-synthesized M@NCNTs composites demonstrate promising candidates in microwave absorption (MWA) application. The minimum reflection loss (RL) of Fe@NCNTs (with 10 wt% loading) is up to -30.43 dB at 3.2 mm, and the effective absorption bandwidth ($RL < -10$ dB) is as wide as 5.7 GHz which benefits from the neighboring dual absorption peaks induced by the intense dielectric relaxation. Co@NCNTs and Ni@NCNTs also have satisfactory effective absorption bandwidth ~4.08 and ~4.72 GHz, respectively. The modified pyrolysis method is low-cost and non-toxic, which could become an industrial technique to synthesize carbonaceous composites for microwave absorption.

Key words: non-toxic; pyrolysis; heterostructure; Fe/Co/Ni@NCNTs; Electromagnetic matching; microwave absorption

1. Introduction

Since the electromagnetic (EM) pollution is becoming a serious technical and social problem, efforts have being dedicated to explore and design new

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