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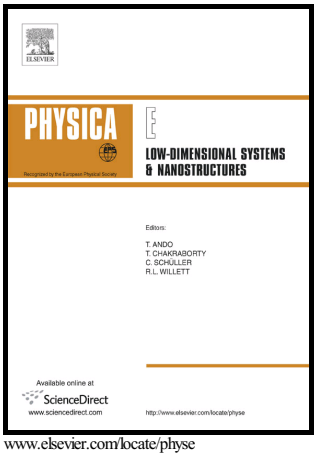

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Jiliang Xie, Xujie Yang, Xingyou Xu, Chao Yang

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Wet chemical method for synthesizing 3D graphene/gold nanocomposite: catalytic reduction of methylene blue

Jiliang Xie[*,1,2] Xujie Yang[1] Xingyou Xu[1,3] and Chao Yang[4]

[1] Chemical Engineering Institute, Nanjing University of Science and Technology Nanjing, 210094, P.R. China

[2] Jiangsu Marine Resources Development Research Institute, Lianyungang 222001, P.R. China

[3] School of Chemical Engineering, Huaihai Institute of Technology, Lianyungang 222005, P.R. China

[4] Institute of Process Engineering, Chinese Academy of Sciences, Beijing, 100190, P.R. China

Corresponding author email: jiliangxie_nust3@foxmail.com

Abstract

In this paper, a simple and environmentally-friendly approach was reported to synthesize a novel 3D composite of graphene/gold nanoparticles (3DG/Au NPs) in one step. A 3D interlaced framework of graphene, which exhibited hierarchically porous structures, generated directly through the distinct driving force during the hydrothermal growth. Meanwhile, Au NPs with high dispersity, which displayed tunable morphologies, were immobilized on the framework, where the as-prepared graphene was employed as the endogenous reducing agent. Compared with AuNPs, the obtained 3DG/Au NPs exhibited remarkably convenient recyclability and high activity for the reduction of methylene blue which is a kind of organic dye.

Keywords: 3D graphene; Au NPs; Wet chemistry; Nanocomposite; Catalytic degradation; Methylene blue

Introduction

So far, in the heterogeneous system, majority of the catalytic reactions have been diffusion-limited [1-3]. Hence, to develop hierarchical three-dimensional (3D) composites are promising in catalysis. In fact, various 3D structures including zeolites [4], carbon [5], mesoporous silica [6], metal oxides [7], flower-like or urchin-like metal oxides [8, 9] and macroporous nickel foam [10] have been successfully employed in catalysis. These 3D structures exhibited various remarkable properties, including high surface area to improve mass transport, distinct synergistic collaboration with catalytic centers, outstanding absorbing capacity towards reactants and high loading performance for active constituents [11, 12]. Thus, they could be employed as supports for catalysts, even used directly as catalysts. For instance, 3D CeO_2-supported Au NPs exhibited an improved catalytic capacity for oxidizing CO at room temperature [13], which indicated that the localized electrons of Ce^{3+} ions in the occupied 4f orbital could facilitate the electronic interaction between the immobilized Au NPs and the reduced CeO_2 [14].