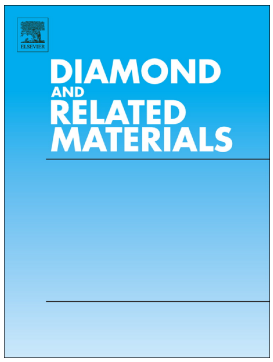

Synthesis of graphene-based nanostructures by the combined method comprising sol-gel and sonochemistry techniques

Elena A. Trusova, Klara V. Kotsareva, Alex N. Kirichenko, Sergey S. Abramchuk, Artem A. Ashmarin, Igor A. Perezhogin

PII: S0925-9635(17)30574-5
DOI: doi:10.1016/j.diamond.2018.03.020
Reference: DIAMAT 7060

To appear in: *Diamond & Related Materials*

Received date: 25 August 2017
Revised date: 1 January 2018
Accepted date: 18 March 2018

Please cite this article as: Elena A. Trusova, Klara V. Kotsareva, Alex N. Kirichenko, Sergey S. Abramchuk, Artem A. Ashmarin, Igor A. Perezhogin , Synthesis of graphene-based nanostructures by the combined method comprising sol-gel and sonochemistry techniques. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Diamat(2017), doi:10.1016/j.diamond.2018.03.020

Synthesis of graphene-based nanostructures by the combined method comprising sol-gel and sonochemistry techniques

Elena A. Trusova[1]*, Klara V. Kotsareva[1], Alex N. Kirichenko[2], Sergey S. Abramchuk[3], Artem A. Ashmarin[1,4], and Igor A. Perezhogin[2,3,5]

[1]Baikov Institute of Metallurgy and Materials Science, RAS, 49 Leninsky pr., Moscow, Russia, 119334
[2]Technological Institute for Superhard and Novel Carbon Materials, 7a Tsentralnaya street, Troitsk, Moscow, Russia, 142190
[3]Lomonosov Moscow State University, GSP-1, Leninskie Gory, Moscow, Russia, 119991
[4]Keldych Research Center, 8, Onezhskaya str., Moscow, Russia, 125438
[5]Moscow Institute of Physics and Technology State University, 141700, Institutskiy per. 9, Dolgoprudny, Moscow Region, Russia, 141701

trusova03@gmail.com

Keywords: graphene; ultradispersed metal oxide powder; graphene-ceramics composites; sol-gel technique; sonochemistry

Abstract

Nanocomposites based on graphene and Co_3O_4, MoO_3, NiO and WO_3 have been synthesized by a combination of sol-gel and sonochemical techniques. N,N-Dimethyloctylamine was used for the formation and stabilization of metal-containing sols and for stabilization of graphene suspension. The structure, morphology and composition of graphene-based nanocomposites were investigated by means of transmission electron microscopy, X-ray diffraction, Raman and FT-IR spectroscopy. It has been shown that the proposed method allows obtaining the hybrid nanoparticles with 10 to 200 nm size consisting of Co_3O_4, MoO_3, NiO or WO_3 crystallites coated with the graphene layers. This method enables preparing chemically homogeneous composite nanopowders for the production of high performance (photo)catalysts and fine-grained ceramics for the energy sector with uniform distribution of components within a volume. It has beens proven experimentally that graphene sheets are involved in the formation of hybrid nanoparticles based on metal oxides as structuring and texturing agents. These results show promise in the synthesis and fabrication of well-defined graphene-based functional materials, including graphene-ceramic hybrids, with a broad scope of applications.

1. Introduction

Over the past decade, a growing interest of researchers has been focused on graphene-ceramic composites [1-3]. The composites consisting of graphene or graphene oxide and metal oxide nanoparticles are attractive as raw materials due to the fact that graphene improves their specific strength, electrical and thermal properties [4-7]. Specific properties of such composites are related to the formation of the chemically bonded graphene–metal oxide interface [1, 8]. Composites based on graphene, graphene oxide or reduced graphene oxide and nanopowders of metal oxides are promising raw products for designing new high-purity materials with a wide range of end use: anodes for Li-ion batteries, supercapacitors, transistors, (photo)catalysts, solar cells, sensor materials, fuel cells, electrochromic devices, etc. [1, 5, 7, 9-12]. As known, beneficial effects of graphene addition on the physicochemical