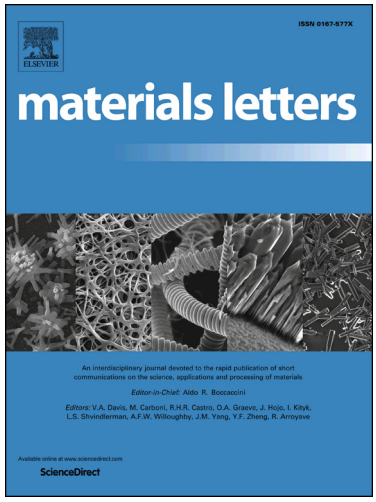
Accepted Manuscript



Novel process of coating Al on graphene involving organic aluminum accompanying microstructure evolution

Z.Y. Zhao, R.D.K. Misra, P.K. Bai, J.F. Gao, Y.J. Li, R.G. Guan, Z.H. Guo

PII: S0167-577X(18)31228-X
DOI: https://doi.org/10.1016/j.matlet.2018.08.036
Reference: MLBLUE 24747

To appear in: *Materials Letters*

Received Date: 14 July 2018
Revised Date: 5 August 2018
Accepted Date: 7 August 2018

Please cite this article as: Z.Y. Zhao, R.D.K. Misra, P.K. Bai, J.F. Gao, Y.J. Li, R.G. Guan, Z.H. Guo, Novel process of coating Al on graphene involving organic aluminum accompanying microstructure evolution, *Materials Letters* (2018), doi: https://doi.org/10.1016/j.matlet.2018.08.036

Novel process of coating Al on graphene involving organic aluminum accompanying microstructure evolution

Z.Y. Zhao[1], R.D.K. Misra[2]*, P.K. Bai[1]*, J. F. Gao[1], Y.J. Li[3], R.G. Guan[4] and Z. H. Guo[5]

[1]School of Materials Science and Engineering,North University of China, Taiyuan 030051, China
[2]Department of Metallurgical and Materials Engineering, 500 W. University Avenue, University of Texas at El Paso, TX 79968, USA
[3]Department of Materials Science and Engineering, Norwegian University of Science and Technology, Alfred Getz vei 2 B, N-7491 Trondheim, Norway
[4]School of Materials Science and Engineering, Northwestern Polytechnical University, Xi'an 710072, China
[5]Integrated Composites Laboratory, Department of Chemical and Biomolecular Engineering, University of Tennessee, Knoxville, Tennessee 37996, USA.
*Corresponding Author: E-mail: baipeikang@nuc.edu.cn (P. Bai), dmisra2@utep.edu(R.D.K. Misra).

Abstract: A novel chemical reduction of organic aluminum for coating Al on the graphene surface is proposed. During the process, Al powder reacted with the $(C_2H_5)_2Br$ solution to produce $(C_2H_5)_3Al$ solution, followed by gradual decomposition of $(C_2H_5)_3Al$ into Al atoms. Al atoms gradually deposited on the surface of graphene, nucleated, grew up, until Al coating was formed on the surface of graphene. With the increase of reaction temperature, the decomposition rate of $(C_2H_5)_3Al$ increased, which was beneficial to the formation of Al atoms and Al coating. The reducing agent, NaH, promoted the reaction and formation of Al coating. When the reaction temperature was optimized to 100℃, and the reaction time was 1.5 h, with NaH added to the solution, high quality Al-coated graphene was obtained.

Keyword: Al, graphene, nanocomposites, microstructure, coating

1. Introduction

Graphene exhibits excellent mechanical properties and high conductivity. These superior properties render graphene as ideal reinforcement for Al matrix composites. Previous research has shown that the addition of few-layer graphene [1], graphene oxide [2, 3], or graphene nanoplatelets improved the mechanical properties of Al alloys [4, 5]. However, due to the poor wettability between graphene and Al, graphene is difficult to disperse in Al matrix [6-8]. Coating metal on graphene surface has been proposed to improve wettability between graphene and Al [9, 10], including chemical reduction, self-assembly, electrochemical deposition, vapor deposition and redox method [11-13]. These methods are mainly used to coat precious metals, copper or nickel on the surface of graphene [14, 15]. If the graphene was added in Al alloy, these precious metals, copper or nickel may be viewed as impurities, which can affect properties of Al alloys. The effective method to reduce these impurities and improve wettability of graphene, is to coat Al on the surface of the graphene. This is difficult via conventional liquid chemical reduction reaction because Al is active and Al atom is difficult to displace from the Al salt solution [16, 17]. A novel