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Fabrication and tribological properties of oil-soluable MoS_2 nanosheets decorated by oleic diethanolamide borate

Pei-Rong Wu, Wei Li, Yu-Mei Feng, Ting Ge, Zan Liu, Zhi-Lin Cheng*

(School of Chemistry and Chemical Engineering, Yangzhou University, Yangzhou 225002, China)

Email:zlcheng224@126.com

Abstract: In this paper, the self-made MoS_2 nanosheets were attempted to be modified with oleic diethanolamide borate (ODAB) through a simple one-step route. The as-modified MoS_2 nanosheets were confirmed by a series of characterizations. The results showed that the MoS_2 nanosheets could be chemically well capped by ODAB to form C-S bonds. Furthermore, the tribological experimental results indicated that the ODAB-MoS_2 nanosheets as lubricant additives could improve the friction properties of base oil. At the optimal adding content of 0.06 wt.%, the average friction coefficient, average wear scar diameter and extreme pressure performance of the ODAB-MoS_2-based oil were decreased by about 27.9%, 22.9% and 17.4% as compared to base oil, respectively. Finally, the friction mechanism was discussed and proposed.

Keywords: MoS_2; nanosheets; modification; tribological properties

1. Introduction

Halloysite nanotubes (HNTs) as a natural aluminosilicate ($Al_2Si_2O_5(OH)_4 \cdot nH_2O$) are of hollow nanotubular structure with a high aspect ratio in the submicron range. Typically, the length of the HNTs is in the range of 50 to 1500 nm, and the inner and outer diameters are in the range of 10 to 30 nm and 40 to 100 nm, respectively. HNTs are considered as ideal candidates for good hard templates to control the morphologies of the nanomaterials owing to the well-defined regular hollow nanotubular structure[1]. They have complex structure and different outside and inside chemistry, signifying that some molecules are more easily adsorbed on their surface[2]. Abdullayev et al.[3] synthesized silver nanorods through thermal decomposition of the silver acetate in the lumen of the HNTs to improve the antibacterial property and the tensile strength of the polymer composite. Furthermore, two-dimensional nanosheets materials could be also prepared by HNTs as hard-template due to the curling layered hollow tubular nanostructure. Wang et al.[4] have obtained mesoporous carbon nanosheets with a high degree of mesoporosity, high specific surface area and large total pore volumes by using HNTs as inorganic matrix and furfuryl alcohol (FA) as carbon precursor. They found that the FA volume concentrations could be adjusted to obtain tunable mesoporous carbon nanosheets[5]. In our team, graphene nanosheets have been synthesized in the curling layered nanostructure of HNTs[6].