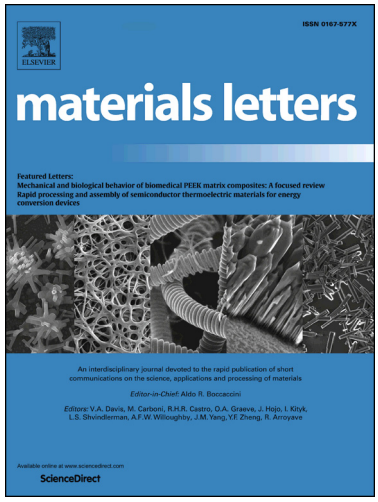

Few-layer black phosphorus: a bright future in electromagnetic absorption

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Few-layer black phosphorus: a bright future in electromagnetic absorption

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ABSTRACT

Few-layer black phosphorus (FL-BP) was prepared by liquid phase exfoliation (LPE) and composites with different weight ratio of FL-BP reveal high electromagnetic absorption (EA) performance in multi-frequency bands. A composite loaded with 30 wt. % of FL-BP showed the broadest effective EA at bandwidth of 6.20 GHz under the thickness of 2.5 mm. Furthermore, when the loading ratio increased to 50 wt. %, FL-BP based absorber has effective EA bandwidth in S (2-4 GHz) band.

Keywords:

Black phosphorus; few-layer; thin films; nanocomposites; electromagnetic absorption; broad band

1. Introduction

During the past decade, the study of 2D nano-materials,[1-3] such as graphene, few-layer (FL) reduced graphene oxide (RGO) and transition metal dichalcogenides (TMDCs) were considered as promising areas in nano-science. Meanwhile, the application of dielectric or magnetic nano-materials in electromagnetic absorption (EA) have also aroused broad interest in the last few years.[4,5] The EA performance of graphene, FL-RGO, MoS_2, as well as their hybrids has been investigated.[6-11] Since 2014, monolayer or few-layer black phosphorus (BP) has drawn great attention as a new 2D material for application in nanoelectronic devices.[12] In contrary to graphene and TMDCs, BP shows a direct bandgap whether it is in monolayer, FL and bulk forms, which greatly facilitates its application in electronic and optoelectronic devices. Because of the unique semiconductor properties, it is very meaningful to study its EA performance. Very recently, the method of producing large quantities of FL-BP nano-sheets by liquid phase exfoliation (LPE) has been established.[13] This makes it experimentally feasible to characterize the EA performance of BP.

2. Experimental section

2.1. Materials

BP crystals were purchased from XF Nano Materials Tech. Co., Ltd, Nanjing, China. N-cyclohexyl-2-pyrrolidone was purchased from Sigma Aldrich.

2.2. Synthesis of FL-BP

FL-BP nano-sheets were prepared as previously reported work.[13]