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A Facile Way to Prepare Phosphorus-Nitrogen-Functionalized Graphene Oxide for Enhancing the Flame Retardancy of Epoxy Resin

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Abstract

In this paper, we have reported a facile way to functionalize graphene oxide (GO) *via* assembling a supermolecular aggregate of piperazine (PiP) and phytic acid (PA) onto the GO surface (PPGO) without using any organic solvent. The functionalization of GO is confirmed by the X-ray photoelectron spectrum (XPS), transmission electron micrographs (TEM) and Raman spectrum. The introduction of 3 wt% PPGO into epoxy resin (EP/PPGO3) results in notable suppression on the fire risk of epoxy resin. In addition, cone calorimeter tests showed that the peak heat release rate (pHRR) was decreased from 727.4 kW/m^2 to 367.5 kW/m^2 (49%), and the peak smoke production rate (pSPR) was decreased from 0.2316 m^2/s to 0.1379 g/s (40%). The improved flame-retardant performance of EP nanocomposites is most likely due to a tripartite cooperative effect from the key components (piperizine, phytic acid, and GO). This strategy demonstrates a facile and efficient approach for fabricating highly effective graphene-based flame retardants for polymers.

Keywords: Epoxy resin; Self-assembled supermolecular aggregate; P, N-containing flame retardants; Graphene; Flame retardancy