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PII: S1385-8947(18)31761-3
DOI: https://doi.org/10.1016/j.cej.2018.09.053
Reference: CEJ 19892

To appear in: *Chemical Engineering Journal*

Received Date: 5 June 2018
Revised Date: 3 August 2018
Accepted Date: 6 September 2018

Please cite this article as: Q. Zhang, Z. Li, X. Li, L. Yu, Z. Zhang, Z. Wu, Zinc ferrite nanoparticle decorated boron nitride nanosheet: preparation, magnetic field arrangement, and flame retardancy, *Chemical Engineering Journal* (2018), doi: https://doi.org/10.1016/j.cej.2018.09.053

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Abstract

Flame-retardant and super paramagnetic zinc ferrite (ZF) was adopted to decorate boron nitride nanosheet (BNNS) through a typical solvothermal method so as to afford ZF-BNNS nanofiller with improved flame-retardant performance. The resultant ZF-BNNS nanofiller was filled in epoxy resin (EP) and exposed to a weak magnetic field (0.05 T) in order to achieve ordered orientation in the EP matrix and improve the flame-retardant performance of EP-matrix composites. Results show that the weak magnetic field accommodates the ordered alignment of ZF-BNNS nanofiller in EP matrix, and the well-ordered ZF-BNNS nanofiller is superior to the randomly distributed one in enhancing the fire resistance of EP. Namely, the well-ordered ZF-BNNS nanofiller is able to reduce the peak heat release rate, peak smoke production release and CO production of EP-matrix nanocomposite by 48.5%, 46.0%, and 66.6%, respectively. This is because the ZF-BNNS nanofiller can increase the char yield of EP at elevated temperatures while layered-ordered BNNS and ZF exhibit synergistic flame-retardant effect: the well-aligned BNNS may act as a strong physical barrier to retard the release and diffusion of thermally decomposed products *via* the so-called "tortuous path" effect, and ZF may act as the catalyst to promote the carbonization and char layer formation. As a result, the density and strength of the carbon layers are increased in association with enhanced insulation shield effect to heat flux, oxygen and combustible pyrolysis products as well as their suppressed