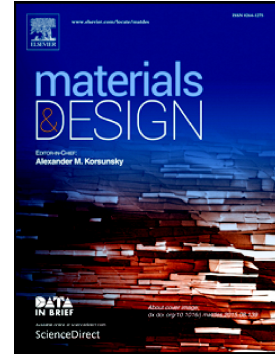


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Inclusion complex between beta-cyclodextrin and phenylphosphonicdiamide as novel bio-based flame retardant to epoxy: inclusion behavior, characterization and flammability

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Abstract

The aim of this work was to study the impact of inclusion complex (IC) between β -cyclodextrin (β -CD) and N, N'-diamyl-p-phenylphosphonicdiamide (P-MA) on the thermal stability and flame retardancy of epoxy resin (EP). IC was synthesized via inclusion process and characterized by ^1H nuclear magnetic resonance (NMR), X-ray diffraction (XRD), differential scanning calorimeter (DSC) and scanning electron microscopy with X-ray microanalysis (SEM-EDS). ^1H NMR was used to identify the mole ratio of β -CD/P-MA in IC, showed that their mole ratio was 1:0.5. The inclusion complex (IC) was proposed to be a char promoter in EP via a combination of the properties of β -CD and P-MA during the combustion. By incorporating the IC, the flame retardancy of EP was expected to be improved. Thermal gravimetric analysis (TGA) showed that the thermal stability of IC was better than those of P-MA and physical mixture of β -CD and P-MA (PM). The impact of IC and PM on thermal stability and flame retardancy in EP were studied by TGA, limiting oxygen index (LOI), UL 94 and cone calorimeter tests. The heat and smoke releases of EP/IC were suppressed compared with those of EP and EP/PM.

Keywords: Bio-based flame retardant, Inclusion behavior, Flame retardancy, Thermal stability, Epoxy.

1. Introduction

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