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Synthesis and Application of Synergistic Azo-boron-BPA / Polydopamine as Efficient Flame Retardant for Poly(lactic acid)

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Abstract

PLA (Polylactic acid) as a bioplastic polymer has limited applications in areas that require high fire safety due to its inherent flammability and dripping when exposed to flames. In this paper, azo-boron-BPA (AZ-A) and polydopamine (PDA) were synthesized, characterized and incorporated into PLA using the solvent approach and hot compression molding. Nuclear magnetic resonance (NMR), Fourier transform infrared spectroscopy (FTIR) and Raman spectra showed that AZ-A and PDA were successfully synthesized. The flame retardant (FR) properties of synergistic AZ-A / PDA were investigated by vertical burning test, limiting oxygen index (LOI), cone calorimeter and thermogravimetric analysis (TGA). TGA analysis showed that synergistic AZ-A / PDA was generally more efficient in reducing the degradation rate of PLA and gave appreciably much higher char residue compared to the individual FR components. The synergistic AZ-A / PDA achieved V-0 rating with LOI value of 23.7% at 10 wt% loading in the ratio 1:1 whereas the individual FR components could only give a V-2 rating. The AZ-A / PDA synergy also resulted in an obvious reduction in PHRR (up to 19%) with increased residue (up to 17.7%). This research work will contribute to and expand the frontiers of knowledge in flame retardant azo boron compounds and their synergies for PLA.

Keywords: Azo-boron, polydopamine, flame retardant, poly(lactic acid).