Accepted Manuscript

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PII: S0141-3910(18)30248-9

DOI: 10.1016/j.polymdegradstab.2018.07.026

Reference: PDST 8610

To appear in: *Polymer Degradation and Stability*

Received Date: 16 May 2018

Revised Date: 23 July 2018

Accepted Date: 29 July 2018

Please cite this article as: Ai L, Chen S, Zeng J, Liu P, Liu W, Pan Y, Liu D, Synthesis and flame retardant properties of cyclophosphazene derivatives containing boron, *Polymer Degradation and Stability* (2018), doi: 10.1016/j.polymdegradstab.2018.07.026.

Synthesis and Flame Retardant Properties of Cyclophosphazene Derivatives Containing Boron

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Abstract: An organic compound hexakis (4-boronic acid-phenoxy)-cyclophosphazene (CP-6B), containing phosphorus, nitrogen, and boron, was synthesized and characterized. Its flame retardant properties in epoxy resin (EP) were investigated. The results showed that the limiting oxygen index (LOI) value of EP/7%CP-6B reached 32.3% and a UL 94 V-0 rating was attained. When 7 wt.% CP-6B was added, the peak heat release rate (pk-HRR), total heat release (THR), average effective heat combustion (av-EHC), average mass loss rate (av-MLR), average CO yield, and average CO_2 yield of EP decreased. In addition, the flame-retardant mechanism was investigated using Laser Raman spectroscopy (LRS), scanning electron microscopy (SEM), X-ray diffraction (XRD), Fourier Transform Infrared (FTIR), energy dispersive X-ray (EDX), and Pyrolysis-gas chromatography mass spectrometry (PY-GC-MS). The results revealed that CP-6B was an efficient flame retardant acting in the gas and condensed phases simultaneously.

Keywords: cyclophosphazene derivatives; boron; epoxy resin; flame retardant mechanism

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