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Synthesis and Flame Retardant Properties of Cyclophosphazene

Derivatives Containing Boron

Lianghui Ai^a, Shanshan Chen^a, Jinming Zeng^a, Ping Liu^a^{*}, Weishi Liu^{a,b}, Yonghong Pan^c,*, Dongfa Liu^c

 ^a State Key Laboratory of Luminescent Materials and Devices, Research Institute of Materials Science, South China University of Technology, Guangzhou 510640, China
^b Guangzhou Shine Polymer Technology Co., Ltd., Guangzhou 511400, China
^c Guangzhou Institute of Quality Supervision Test, Guangzhou 510110, China

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 CO₂ 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

^{*} Corresponding author. Tel.: +86 20 87111686.

E-mail address: mcpliu@scut.edu.cn (P. Liu).

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