Accepted Manuscript

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PII: S0141-3910(17)30334-8

DOI: 10.1016/j.polymdegradstab.2017.10.017

Reference: PDST 8384

To appear in: *Polymer Degradation and Stability*

Received Date: 18 August 2017

Revised Date: 22 October 2017

Accepted Date: 28 October 2017

Please cite this article as: Wang Y, Wang F, Dong Q, Xie M, Liu P, Ding Y, Zhang S, Yang M, Zheng G, Core-shell expandable graphite @ aluminum hydroxide as a flame-retardant for rigid polyurethane foams, *Polymer Degradation and Stability* (2017), doi: 10.1016/j.polymdegradstab.2017.10.017.

Core-shell expandable graphite @ aluminum hydroxide as a flame-retardant for rigid polyurethane foams

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Abstract: To enhance the flame-retardant performance of expandable graphite (EG) in rigid polyurethane foam (RPUF), EG particles were encapsulated with inorganic nanoparticles, namely aluminum hydroxide (ATH), forming complex particles EG@ATH with core-shell structure. After the deposition of ATH shell, the expandability of the particles was enhanced from 163 to 197 ml/g, leading to better flame-retardant performance in RPUF. At a content of 11.5 wt%, the limited oxygen index could be increased from 21.5 % to 29.6 % by EG@ATH, in comparison to 27.5% by the physical mixture of EG and ATH (EG+ATH). Besides, EG@ATH exhibited better performance than EG+ATH on reducing the total smoke release and CO production. It is worth noticing that ATH could react with isocyanate groups, which was confirmed through FTIR. As a result, the interaction between the core-shell particles and the polymer matrix was enhanced, which protected the cell structure of RPUF from destroying by EG particles. The improved flame-retardant performance of EG@ATH, together with their low-cost, easy fabrication and especially friendliness to the environment, make it prospective in applications for flame retardancy of RPUF.