Development of new halogen-free flame retardant polymer materials

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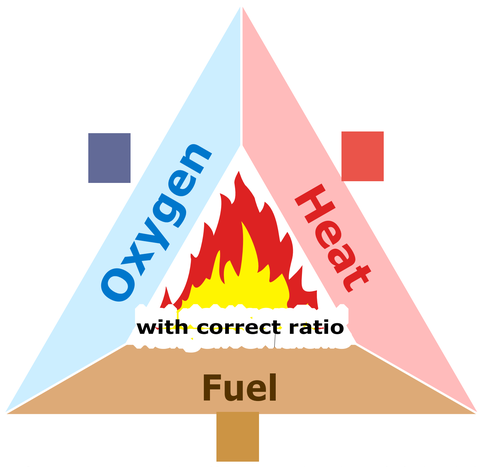

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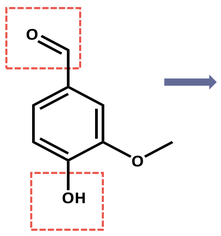
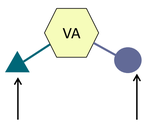
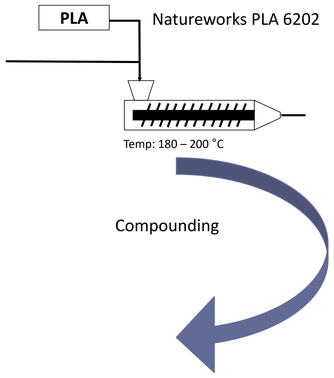
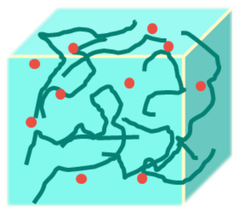
Fire protection of polymeric materials aims to prevent heat transport, fuel generation and availability of oxygen at the fire, thus minimizing the development of toxic gases and smoke to allow victims time for escape.
Flame retardants cut off one, two or all three components necessary for the fire to a certain extent. Existing non-halogenated solutions like $Mg(OH)_2$ and AlOOH alter severely the mechanical performance due to the high necessary loading. Organophosphorous compounds might act in both condensed and gas phase, but dependent on their structure are suspicious of environmental accumulating and health affecting. Therefore, nontoxic and degradable FRs are under investigation.

Vanillin based flame retardant for PLA







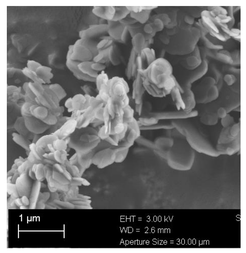


Renewable vanillin based flame retardant for poly (lactic acid): 5% modified Vanillin lead to UL94: V-0 and LOI 25.8 and a plasticizing effect of PLA at the same time.

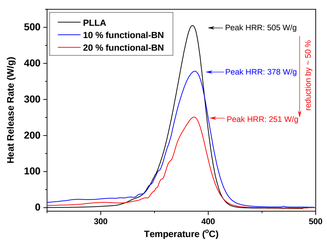
Natural phosphorous flame retardants

Phytic acid ($C_6H_{18}O_{24}P_6$) is a natural occuring phosphorous source and can be derived from rice husk

functionalized submicron hexagonal Boron Nitride

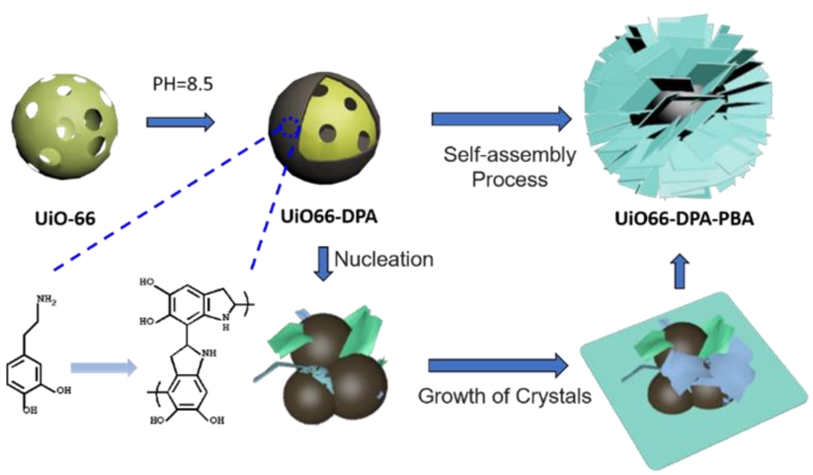


Reduction in flammability:
Heat Release Rate –50 %
LOI: 18.5 => 27.5



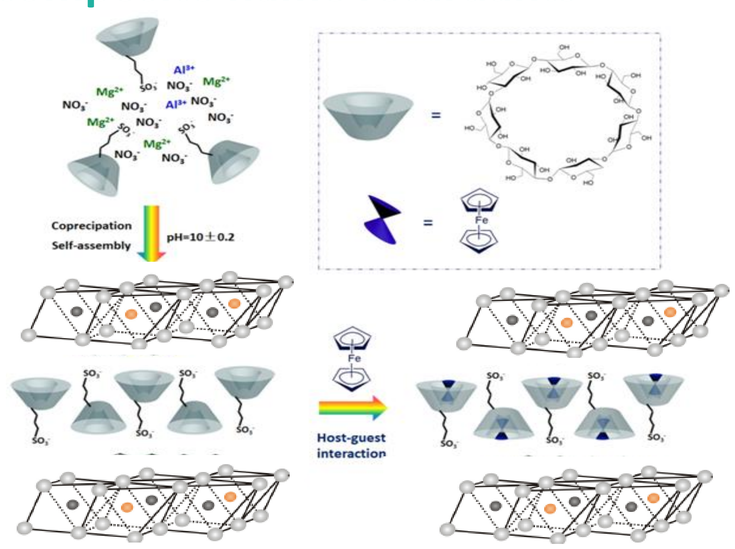
Flame retardant concept for polymers with active phosphorous component derived from food residues: rice husk as resource for phytic acid to catalyze char formation combined with ceramics (BN) result in high efficiency.

MOF-based flame retardants



Metal Organic Framwork (MOF) decorated with Polydopamine and Ni-based Prussian Blue Analoga: 3 % of this hybride lead to 50 % reduction in peak heat release rate (pHRR) and UL-94: V-1 in epoxy.

Nanocomposite flame retardants



Combination of β-cyclodextrin and Ferrocene in Layered Double Hydroxides as flame retardant in epoxy: 4 % modified LDH results in UL94 V-0 and LOI 32.