# Thermally Stable and Flame Retardant Polymer Nanocomposites

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# 11

# Flame retardant polymer nanocomposites with fullerenes as filler

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## 11.1 Background

Organic polymers are rapidly and increasingly taking the place of traditional inorganic and metallic materials in various fields owing to their excellent properties, such as low density, resistance to erosion, and ease of processing [1, 2]. However, organic polymers are inherently flammable; their use can cause the occurrence of large fires and, consequently, loss of lives and properties. Thus, enhancing the flame retardancy of these organic polymers is becoming more and more imperative with their wider application, especially in fields such as electronics where high flame retardancy is required.[1]

For traditional flame retardants, on one hand, a very high loading is usually needed to meet flame retardancy demands, which can lead to the deterioration of mechanical properties; on the other hand, utilization of flame retardants can cause environmental problems. Fortunately, recent studies have suggested that nanoscale fillers such as clay minerals [3–7], carbon nanotubes (CNTs) [1, 8–12], and layered double hydroxides (LDHs) [13–16] can significantly improve the thermal stability and reduce the flammability of polymeric materials at very low loading levels, usually less than 3% by mass. Such nanoscale fillers are highly attractive because they are environmentally friendly and can simultaneously improve the physical properties and flame retardancy of polymeric materials. Many reports about clays, CNTs, and LDHs as flame retardants for polymer composites have been published in the past few years. Fullerenes have also recently been found to be another candidate as highly effective flame retardants for polymeric materials [17–20]. In this chapter, we will focus on the effects of fullerenes [$C_{60}$] on the thermal degradation behavior and flame retardancy of polypropylene (PP).

## 11.2 Flame retardancy of polymer/fullerene nanocomposites

### *11.2.1 Morphology*

The diameter of the fullerene [$C_{60}$] molecule is 0.71 nm; its crystal size differs with different methods of fabrication [21], from 50 to 120 nm. PP/$C_{60}$ nanocomposites were fabricated

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