



Short Communication

Synthesis and characterization of kaolin with polystyrene via in-situ polymerization and their application on polypropylene

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ABSTRACT

To improve both the mechanical and thermal properties of kaolin/polypropylene (PP) composites, kaolin was modified by using 3-(trimethoxysilyl) propylmethacrylate (YDH-570) as a coupling agent to form polymerizable particle. Styrene was radically polymerized through the immobilized vinyl using benzoyl peroxide (BPO) as an initiator. Fourier transform-infrared (FTIR) spectroscopy, particle size distribution, X-ray diffraction (XRD) and thermo-gravimetric analysis (TGA) well demonstrated that the kaolin–polystyrene particles were successfully synthesized via in-situ polymerization. While the modified kaolin and raw kaolin were introduced into the PP matrix, it could be concluded that modified kaolin/PP composites have better mechanical and thermal properties than raw kaolin/PP composites, and these improvements were attributed to the desirable dispersion of kaolin in PP matrix.

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1. Introduction

Polypropylene (PP) is widely used in many areas such as automotive, construction and other industrial applications. However, its brittleness under low temperature and notch-sensitive feature could not meet engineering requirements. Recently, fillers-reinforcement polymer composites have attracted more attention, because the inclusion of fillers alters the structural, thermal and mechanical properties of the composites [1–3]. Particular interests are nanocomposites consisting of organically modified layered silicate because they often exhibit remarkable properties compared with those of virgin polymer [4]. Kaolin is readily available, a cost-effective mineral filler and is used to reinforce the polymers. However, when particle fillers are incorporated into polymers, the strength, elongation and impact properties are normally sacrificed, because of their strong tendency to self-agglomerate [5,6]. One of the best ways to avoid aggregation is to graft polymer chains onto the particles covalently [7–9].

Zongneng Qi reported that toluene-2,4-di-isocyanate (TDI) could selectively react with hydroxyl group of montmorillonite (MMT) and prepared polystyrene (PS)/TDI-modified MMT hybrids [10]. Robert synthesized two kinds of photoresponsive azobenzene polyurethane functionalized multiwalled carbon nanotubes (AzoP-U-MWNTs) by in-situ polycondensation. The hard core and the soft shell were MWNT and the polymer layer respectively [11]. Zhong-

Ming Li prepared the pulverized expandable graphite-poly (methyl methacrylate) (pEG-PMMA) particles via emulsion polymerization with 22.09 wt% PMMA and found that 10 wt% of pEG-PMMA particles into rigid polyurethane foam (RPUF) led to a considerable increase in the mechanical properties and flame-retardation behavior [3]. Zhengping Fang investigated the effects of organo-clay particles and dodecyl sulfonate intercalated layered double hydroxide (SDS-LDH) on the thermal stability and flame retardancy [12]. However, there is little research on modification of kaolin through in-situ suspension polymerization.

In this paper, we modified the kaolin using an unsaturated coupling agent to anchor PS chains to the kaolin and prepared PP composites with modified kaolin, and investigated the effects of kaolin on mechanical and thermal properties of PP. It was expected that the modified kaolin could be dispersed well in PP.

2. Experimental

2.1. Materials

PP was purchased from Fujian Petrochemical Co., Ltd. Kaolin (the particle size was about 3.3 μm) was supplied by LongYan Kaolinclay Co., Ltd. The coupling agent 3-(trimethoxysilyl) propylmethacrylate (YDH-570) (>97% purity, 1.040 g/ml) was purchased from Nanjing YuDeHeng Fine Chemical Co., Ltd. Benzoyl peroxide (BPO) (Sinopharm Group) was first dissolved in chloroform, recrystallized from cold methanol and dried before use. Styrene (St) was purified by distillation. Chloroform and polyvinyl alcohol (PVA) were used without any treatment. The grafted PP was prepared

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