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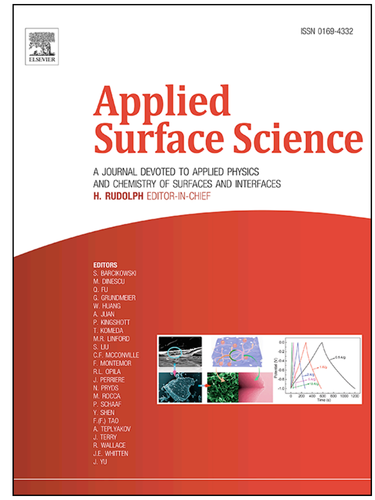

Full Length Article

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Surface modification of magnesium hydroxide by wet process and effect on the thermal stability of silicone rubber

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ABSTRACT: This work reported the surface modification of magnesium hydroxide (MH) employing vinyltriethoxysilane (VTES) by wet process for the sake of improving the compatibility between magnesium hydroxide (MH) and silicone rubbers (SR). The morphology, surface property and dispersion stability in organic phase of VTES-modified MH (VTES-MH) were studied in detail. Fourier transform infrared (FT-IR) spectra and photoelectron spectra (XPS) proved that the VTES molecules were chemically bound to the surface of MH via the reaction between Si-O-C_2H_5 of VTES and hydroxyl group of MH. The contact angle tests implied that the surface of MH was transformed from hydrophilic to hydrophobic successfully with the interface energy of MH decreased from 63.35 to 25.13 $mJ \cdot m^{-2}$. Dispersion stability tests showed the dispersibility of MH nanoparticles in the organic phase was significantly improved after modification. Finally, the VTES-MH was applied as a flame retardant to enhance the thermal stability and reduce the flammability of SR. The VTES-MH showed good compatibility to SR even at high loading amount (5:5) and a high limit oxygen index (LOI) of 40.2% was obtained. The formation mechanism of SR/VTES-MH composites was also discussed.

Key words：Magnesium hydroxide; VTES; Silicone rubber; Thermal stability; Flame retardant

1. Introduction

Silicone rubbers (SR) have been widely used for automotive applications, electronics, medical devices and implants, due to their excellent elasticity, dynamic fatigue and high electrical resistance properties [1-3]. However, the flammability of silicone rubber restricted its applications. It is highly desirable to improve the flame retardancy of SR by the incorporation of fire retardant such as phosphates, magnesium hydroxide, aluminium hydroxide and so on [4-6]. Magnesium hydroxide (MH), as a kind of environmentally friendly flame retardant, has been widely used in halogen-free polymeric materials due to its high decomposition temperature (about 340 °C, 140 °C higher than that of aluminium hydroxide), smoke suppressibility and non-toxicity. However, MH has a poor compatibility with polymer matrix because of its high interface energy and strong hydrophilicity [7-11]. The primary MH nanoparticles are prone to aggregate in polymer matrix and it is difficult to form homogeneous and well-stabilized composites. In addition, a high loading of MH is usually required to guarantee the desired flame retardant effect, which leads to sharply decline in the mechanical properties and rheological properties of the polymers [12-15]. Surface modification has been demonstrated as a simple and effective approach to afford MH with hydrophobicity and improve the dispersion stability of MH in polymers [16-18]. Among various modifier, silane coupling agent has attracted much attention due to its amphiphilicity [19-21]. Zhu *et al.* reported the surface modification of magnesium hydroxide sulfate hydrate (MHSH) whiskers using vinyltriethoxysilane (VTES) by dry process to transform the surface of MHSH from hydrophilic to hydrophobic. The thermal stability, dispersibility and the