Abstract

Due to their lesser strength, polyolefins are known to have only moderately adequate mechanical properties which restrict its use to certain applications. One way of improving the mechanical properties and/or strength of polyolefins is by adding appropriate filler to them. In recent years, composites consisting of polyolefin and inorganic particulate fillers have attained remarkable improvements in their mechanical and thermal properties in comparison to pure polyolefins. Also, reinforcing particulate fillers with nanometric size have attracted considerable attention of polymer scientist working in the filed of structural composites. Silica has been used extensively in rubber industry as a reinforcing filler, and, also, as a viscosity modifier. In the present scenario most of the research is focused on nanometric sized silica particles instead of micro size particles for the development of organic-inorganic hybrid materials. However, the hydrophilic silica particles inhibit the compatibility with hydrophilic polymer matrix in organic-inorganic hybrid materials.

The study carried out in the present work has been aimed at synthesizing novel nanocomposites based on *polyolefins* and precipitated *nanosilica* in order to enhance the mechanical properties of pure polyolefins for certain applications such as structural materials in automobile industry. In order to promote compatibility between hydrophilic nanosilica particles and polyolefin matrix, and, also, to reduce the agglomeration behavior of the particles, the nanosilica particles are pre-functionalized with organic functional modifiers. The organic functional modifiers used in the present study are *diglycidyl ether of bisphenol-A*, *organo zinc compound* and *triacetoxyvinylsilane*. The polyolefins chosen as matrix materials are *low-density polyethylene*, *ethylene-octene copolymer*, *propylene-ethylene copolymer* and *polypropylene*. We have preferred *melt- mixing* technique for the synthesis of polyolefin nanocomposites because it is an industrially viable method for large scale production. The *structural*, *mechanical*, *dynamic mechanical* and *thermal* properties and *morphology* and *fracture nature* of the synthesized polyolefin nanocomposites has been analyzed as a function of surface functionalization of nanosilica particles by using Wide-angle X-ray diffractometer (WAXD), Thermo Gravimetric Analyzer (TGA), Differential Scanning Calorimeter (DSC), Dynamic Mechanical Analyzer (DMA), Scanning Electron Microscope (SEM) and Atomic Force microscope (AFM).

In another study, *in situ* polyethylene and polypropylene nanocomposites have been synthesized using a supported metallocene catalyst by the *gas-phase polymerization* technique. The ethylene and polyethylene nanocomposites were obtained in *situ* by polymerizing ethylene monomer gas and propylene monomer gas, respectively. Nanosilica-supported-Zirconocene was used as the supported metallocene catalyst in the presence of *nanofillers*. The fillers used are Cloisite-*20A*, *Kaolin* and *nanosilica*, respectively. Three different *in situ* Polypropylene *(PP)* and polyethylene nanocomposites, i.e., Cloisite-20A filled polypropylene *(CFPP)*, Kaolin-filled polypropylene *(KFPP)*, nanosilica-filled polypropylene *(SFPP)*, Cloisite-20A-filled polyethylene *(CFPE)*, Kaolin-filled polyethylene *(KFPE)* and nanosilica-filled polyethylene *(SFPE)* have been synthesized, separately. The *in situ* polypropylene and polyethylene nanocomposites were characterized using Fourier transform infrared Spectroscope (FTIR), Solid state ^{13}C NMR (Nuclear Magnetic Resonance) Spectroscope, Wide-angle X-ray diffractometer (WAXD), Thermogravimetric analyzer (TGA), Differential Scanning Calorimeter (DSC) and Scanning electron microscope (SEM).

Keywords: damping factor; elastic modulus; encapsulation; epoxy resin modification; gas-phase polymerization; glass transition temperature; in-situ nanocomposites; loss modulus; Methylaluminoxane; nanocomposites; nanosilica; nanosilica-supported-Zirconocene; nucleation; nucleating agent; organic functionalization; reinforcing filler; static modulus; storage modulus; thermal stability; toughness; zinc-ion coating