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Environmentally Benign Materials Based on Biodegradable Polymers and Clay

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This presentation will highlight on recent developments in preparation, characterization, properties, crystallization behaviours, melt rheology, processing, and future applications possibilities of green nanocomposites based on biodegradable polymers and layered silicates. In recent years, these materials are attracting great interest in materials science research. Montmorillonite and hectorite are among the most commonly used smectite-type layered silicates for the preparation of nanocomposites. In their pristine form they are hydrophilic in nature, and this property makes them very difficult to disperse into biodegradable polymer matrices. The most common strategy to overcome this difficulty is to replace the interlayer cations with quarternized ammonium or phosphonium cations, preferably with long alkyl chains.

A wide range of biodegradable polymer matrices will be presented in this presentation with a special emphasis on polylactide because of more eco-friendliness from its origin as contrast to the fully petroleum-based biodegradable polymers and control of carbon dioxide balance after their composting. Preparative techniques include (i) intercalation of polymers or pre-polymers from the solution, (ii) in-situ intercalative polymerization method, and (iii) the melt intercalation method.

This new family of composite materials frequently exhibits remarkable improvements of mechanical and other properties when compared with virgin polymers or conventional micro- and macro-composites. Improvements can include a high storage modulus both in solid and molten states, increased tensile and flexural properties, a decrease in gas permeability and flammability, increased heat distortion temperature and thermal stability, increase in the biodegradation rate, and so forth.