Plenary Lecture for the 2004 International Meeting for the Polymer Processing Society

Title: Principles Associated with the Preparations of Organoclay Nanocomposites, and Blends of Thermotropic Liquid-Crystalline Polymer and Flexible Homopolymer

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ABSTRACT

The nanocomposites composed of a thermoplastic polymer and an organoclay have been prepared basically by two different methods: by in-situ polymerization or by melt blending or solution blending. In conducting in-situ polymerization, monomers with functional groups are polymerized in the presence of chemically modified layered silicates, such that the exfoliated layered silicates can be chemically bonded to the polymer matrix. This method was first introduced by the Toyota scientists, and later other research groups also prepared organoclay nanocomposites using a similar method. This approach to nanocomposite preparation has an advantage over melt blending or solution blending in that it can give rise to a very high degree of exfoliation of layered silicate aggregates in the nanocomposites. However, in-situ polymerization of monomers in the presence of chemically modified layered silicates is not always possible and thus under such circumstances melt blending or solution blending must be employed to prepare organoclay nanocomposites. When a thermoplastic polymer is mixed with an organoclay, it either intercalates or exfoliates the layered silicate aggregates. In general, intercalation is observed when a polymer matrix and layered silicates do not have sufficient attractive interactions, while exfoliation is observed when a polymer matrix and layered silicates have strong attractive interactions. From the point of view of obtaining markedly improved physical/mechanical properties of nanocomposites, exfoliation is preferred to intercalation. The nanocomposites composed of layered silicates and a thermoplastic polymer do not provide enhanced mechanical and/or physical properties of the thermoplastic polymer, *unless* the layered silicates and polymer have attractive interactions. The same principle applies to the preparation of blends of thermotropic liquid-crystalline polymer (TLCP) and flexible homopolymer (FH). That is, there ought to be attractive interactions between TLCP and FH in order to provide enhanced mechanical and/or physical properties of TLCP/FH blends. In this lecture, several examples of organoclay nanocomposites and TLCP/FH blends will be presented to demonstrate the validity of the principles.