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In situ synthesis of poly(methyl methacrylate)/layered double hydroxides (LDHs) nanocomposites

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Abstract – Some layered double hydroxides have been synthesized considering different factors (trivalent and divalent cations combinations, density of charge in the clay layers and anions intercalated). Poly(methyl methacrylate)/layered double hydroxides have been synthesized by in situ polymerization considering some different anionic clay concentrations and compositions. Nanocomposites have been evaluated by X-ray diffraction and transmission electron microscopy. The optical transparency has been investigated by UV/visible transmission spectra and the relative resistance on termo-oxidation has been established by oxidation induction temperature.

Recently, clay/polymer nanocomposites have attracted considerable interest as reinforcements of polymeric materials (Wang et al. 2006). These materials have received considerable interest since Toyota's group published in 1989 their work about a composite, which had high mechanic and fire resistance. This new family of composite materials frequently exhibits remarkable improvements of material properties when compared with the matrix polymers alone or conventional micro- and macro-composite materials. Improvements can include a high storage modulus, both in solid and melt states, increased tensile and flexural properties, a decrease in gas permeability and flammability, increased heat distortion temperature, an increase in the biodegradability rate of biodegradable polymers, and so forth (Ray, S., e Okamoto, M., 2003).

LDHs have been synthesized by co-precipitation method. Experiments were performed in a Nitrogen atmosphere to avoid the presence of carbonate. Salts and NaOH were weighed and dissolved in deionized water. The anion organic that was weighed and dissolved in deionized water was put inside the reactor. The salt solution was slowly dropped into the stirred anion organic solution at 35°C. It was used a NaOH solution to maintain the pH solution at 10. After the addition of all reagents, the solution was left in pH 8 and the system was kept without agitation for 12 hours. After this time the solution was centrifuged for 10 minutes and the supernatant was removed. Deionized water was added to the precipitate and the solution was centrifuged once more. This process was repeated for 4 times.

Nanocomposites were prepared by in situ bulk polymerization. In order to purify the styrene it was washed for three times with an aquous NaOH solution and then deionized water. After that it was dried over calcium chloride and distilled under vacuum. Desired quantities of styrene and anionic clays were weighed, mixed for 1 hour at room temperature and then placed in ampoules. These ampoules were degassed by three freeze/ thaw cycles under vacuum in order to remove the oxygen. After sealing the ampoules, they were placed in a controlled oil bath at a selected temperature. Ampoules were withdrawn when the polymerization was complete.

The most of published works about polymer/clay nanocomposites consider layered natural silicates as montmorillonite. In this work, the in situ bulk polymerization of methyl methacrylate and layered double hydroxides modified with organic anions as sodium dodecyl sulfate (SDS) has been investigated. Layered double hydroxides, although are not abundant in nature, can be synthesized in a relatively low cost (Crepaldi, E., e Valim, J., 1998).

Poly(methyl methacrylate) is a clear plastic that can substitute the glass. It presents some advantages as its transparency even at high thickness, good chemical resistance, high resistance to weathering, impact resistance, and so forth.

The properties of the nanocomposites considering different factors of the anionic clays: divalent and trivalent cations combinations, ratios between the cations and some intercalated anions have been studied. Besides nanocomposites with different LDHs concentrations have been synthesized.

Nanocomposites have been analyzed by X-ray diffraction, transmission electron microscopy, Fourier transform infrared spectrometer, UV/vis transmission spectra and oxidation induction temperature.

References

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