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Reactive Blending of PP/POSS nanocomposites: Morphology and Dynamic-mechanical Behavior

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Abstract – Distinct functional groups and concentrations of polyhedral oligomeric silsesquioxanes (POSS) of closed cages were investigated in the nanostructuration of polypropylene by reactive processing. An isotactic polypropylene was melt-mixed with POSS (OctaIsobutyl, AlilIsobutyl and OctaVinyl-POSS) using dicumil peroxide (DCP) as radical initiator. The morphology was analyzed by transmission electronic microscopy and X-ray diffraction. Modifications on crystalline structure formation and crystallinity were also observed. The viscoelastic behavior was measured by dynamic-mechanical analyses. Important alterations in stiffness and in temperature transitions were also measured.

Functional groups of polyhedral oligomeric silsesquioxane (POSS) of closed cages, used to nanostructure an isotactic polypropylene (*i*PP) by reactive processing have been investigated. The *i*PP without addictives was melt-mixed with three distinct POSS (OctaIsobutyl, AllylIsobutyl and Octavinyl-POSS) in concentrations of 0.5, 1, 2 and 5% each. To modify the reaction capacity of *i*PP dicumil peroxide (DCP) as radical initiator was used. Reference mixtures were prepared by traditional processing, i.e. without DCP, with 2% POSS and blank.

To characterize the nanocomposite morphology transmission electronic microscopy (TEM) and X-ray diffraction (XRD) were used. The viscoelastic behavior in solid state was measured by dynamic-mechanical analyses (DMA). The samples were produced by injection molding at 190° C.

Viscoelastic and morphological important features were identified as being dependent on chemical reaction and concentration of POSS. The OctaIsobutil-POSS (OI) incorporation resulted in crystalline structure modifications, e.g., β-form non-formation and crystallinity reduction. Also, reduction in slippage between crystallites temperature (T_α*) and discrete increase in elastic and viscous moduli were measured in dependence on OI concentrations. The global effects characterized low compatibility between OI and *i*PP.

With AllylIsobutil-POSS (AL) additions β-form non-formation and more intense crystallinity reduction were observed. However, important stiffness increase and T_α* modifications were measured. Intense chemical reaction between AL and *i*PP seems to be altered by DCP. These effects characterized modifications in molecular interactions of *i*PP.

As result of Octavinyl-POSS (OV) incorporation maintenance of crystallinity and increase in stiffness were observed. OV seems to create nanocomposites with ramified and crosslinked chains in dependence of concentrations. These effects were a consequence of more than a vinyl reactive group linking with *i*PP chains.

The segregated crystal forms of POSS were observed by TEM (Figure 1).

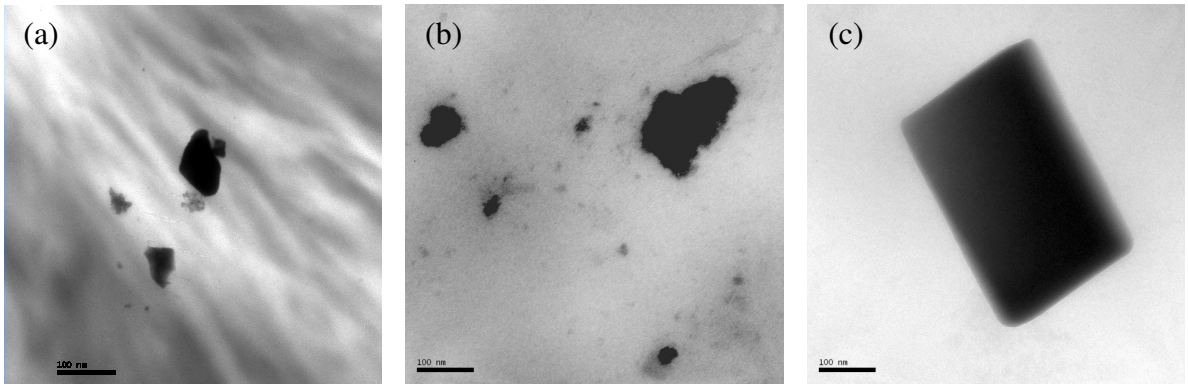

Figure 1: TEM image of (a) *i*PP/OI, (b) *i*PP/AL and (c) *i*PP/ OV nanocomposites by reactive processing.