

Polypropylene-based nano-composite formation: Delamination of organically modified layered filler via solid-state processing

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The interaction between polymer matrix and organically modified layered filler (OMLF) is important for the preparation of nano-composites. However, during melt compound with non-polar polymer matrix, like polypropylene (PP), the shear stress applied to OMLF is very weak because of no polarity of the polymer matrix. In order to apply shear stress to OMLF effectively, we conducted solid-state processing. The mixture of PP and OMLF (95/5 wt) was subjected to the processing using alumina mortar heated 65 °C, below T_m of PP (i.e., PP is still at the solid-state), and grind 8 hours before melt compound. On X-ray diffraction, the OMLF d(001) peak was broaden and peak position shifted slightly. The mixture after melt compound exhibited disorder and delaminated layer structure with the thickness of 2-10 nm into PP matrix through TEM observations. On the contrary, nano-composite prepared by melt compounding at 180 °C for 3 min (without solid-state processing) showed the large stacked silicate layers in the PP matrix. Furthermore, instead of using alumina mortar, we carried out solid-state processing using internal mixer. X-ray diffraction result and TEM observation exhibited similar results. The solid-state processing led to delaminate of the silicate layers and attained the discrete dispersion.