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## Fundamental Insight Into Polymer Nanocomposites

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In 1997, Toyota Group has demonstrated that incorporation of small amount of clay particles (2-6wt%) into a thermoplastic polymeric matrix can generate enhanced properties such as thermal and UV resistance, low permeability towards gases and to some extent improved mechanical properties. Since then, thousands of papers have been published on the subject. The majority of the papers, if not all, use chemical or mechanical approaches to reach exfoliation (delamination and dispersion of individual clay lamellae inside the polymeric matrix). Such exfoliation is claimed to impart the polymer nanocomposites with enhanced mechanical properties. The second well known claim is that high shear stresses are required to destroy the clay galleries and to exfoliate the clay lamellae. The third claim is that an initial intercalated structure is needed to allow polymeric chains to penetrate the galleries and to exert local stresses that would exfoliate the structure under mechanical shearing.

We will show in this communication that the first two claims violate the basic concepts of physics and we will support our critical analysis providing experimental proves using the state-of-the art experimental design. We will also show that although the third claim is well sound, the reason for intercalation is more complex than the simple picture of chains penetration into the confined space between the clay galleries.