ULTRASOUND EFFECT ON DISPERSION AND DISTRIBUTION OF GRAPHITIC MATERIALS INSIDE DIFFERENT PDMS

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ABSTRACT

For decades, the creation of new materials by mixing nanoparticles with polymeric matrices continues to attract the attention of industrialists and academics. Indeed, adding nanoparticles with better electrical or mechanical properties, such as graphitic materials, to polymers, allows obtaining enhanced materials for multiple applications including automotive, energy storage, aerospace, biomedical and more. Nevertheless, performance improvement is highly dependent on the achievement of good distribution and dispersion of the nanoparticles inside the host polymer matrix. In this context, it has been shown, in the literature, that sonication can be an effective method to obtain an efficient dispersion of fillers such as clay and carbon nanotubes inside solvents. However, few studies have investigated sonication for dispersing nanoparticles inside highly viscous mediums such as molten polymers. Moreover, the propagation of the ultrasonic waves within the molten polymers and nanocomposites is still not clearly understood. In this work, the effect of ultrasonic vibration on graphitic materials distribution and dispersion in polydimethylsiloxane, PDMS, was investigated. PDMS grades of different viscosities (3, 30, and 300 Pa.s) were hand-mixed with 0.5 wt% graphitic materials of three different sizes distribution (D90* = 33, 40, or 128 μm), then an ultrasound treatment was applied for 3 minutes with different amplitudes (20, 50 and 90%) and pulses (10, 50, 100%). The continuous ultrasound treatments (i.e. the 100% pulse) were filmed using a high-speed camera in order to observe the mixing pattern. Furthermore, an optical microscope has been used to evaluate the distribution and dispersion of the samples (employing a Python program). The results revealed that the ultrasound treatment effect is dependent on the particle size and the fluid viscosity.
*D90 means 90% of the particles have a size below it.