

SUPERCRITICAL CARBON DIOXIDE AS A GREEN FOAMING AGENT: APPLICATION FOR THE PURPOSE OF POLYMER/CARBON NANOTUBE FOAMS

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Thanks to its nontoxic, unflammable and easy recycle properties, its abundance and cheap price, many researchers has widely used supercritical carbon dioxide (scCO₂) fluid as a physical blowing agent for the foaming of different polymer/clay nanocomposites such as: Polypropylene/clay^[1,2], polycarbonate/clay^[3], polystyrene/clay^[4,5], poly(methylmethacrylate)/clay^[5], polylactide/clay^[6].

Similarly to clay, carbon nanotubes can play the roles of fillers in polymer; it can efficiently enhance the mechanic properties, impact resistance, and thermal stability of materials^[7-8]...Moreover, compared to clay, carbon nanotubes have also the capacity to impart electrical conductivity. For these reasons, CNTs/polymer materials have been widely investigated for EMI shielding purposes. However, a major drawback of these nanocomposites is a high propensity to reflect the electromagnetic radiations rather than to absorb them. Indeed, the reflection of the signals results from a mismatch between the wave impedances for the signal propagating into air and into the absorbing material, respectively. The introduction of air into these nanocomposites by the formation of foam will be favorable to the matching of the wave impedances of the expanded material and the ambient atmosphere.

Two different methods have been used for the foaming of poly(methylmethacrylate) (PMMA) nanocomposites: the one step method and the two steps method. The one-step process consists in saturating the sample in a high pressure vessel with CO₂ at a temperature slightly over the glass transition temperature of the polymer. The sample is left to soak for a few hours. Then, the pressure is released inducing the foaming of the polymer. In the two-step foaming process, gas saturation occurs at a temperature lower than T_g so that when the vessel is rapidly depressurized, no expansion of the polymer occurs. The sample is then quickly placed in a hot press, in order to induce foaming. The influence of different parameters have been studied such as the temperature, time and pressure of scCO₂ impregnation, the temperature of foaming... and the morphology of these samples were investigated by SEM (Scanning Electronic Microscopy).

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