142bh Nano– and Layered–Morpholgies in Atactic/Syndiotactic Polystyrene Blends

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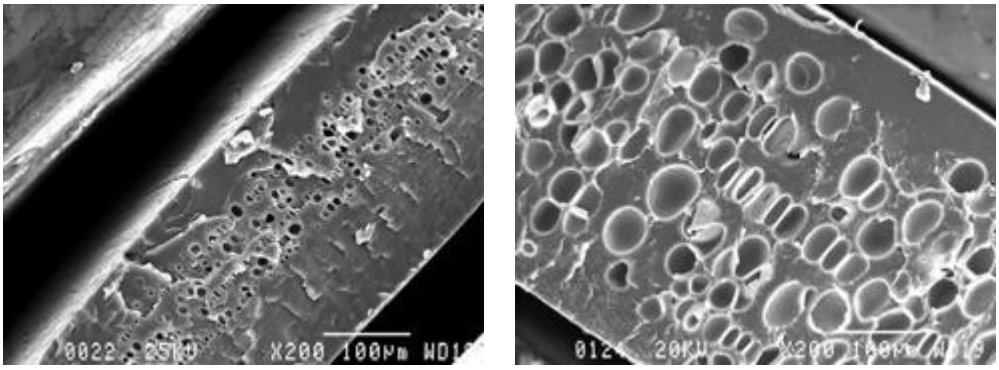
There have been reported numerous studies on the generation of cellular structures in thermoplastic polymers. The process generally involves saturating the polymer with a compressed or supercritical fluid, such as CO_2, and then creating conditions whereby the dissolved fluid rapidly egresses the solution either below the nominal glass transition temperature T_g or slightly above the crystalline melting temperature of the polymer. Such a process normally gives a uniform cellular structure with cell size in the range 10 to 100 microns. However, there do not appear to be any studies on the application of a similar process on polymer blends, and to establish the effect of the blend composition on the resulting morphology. It is noted that transport properties of CO_2 in polymer blends have been widely studied.

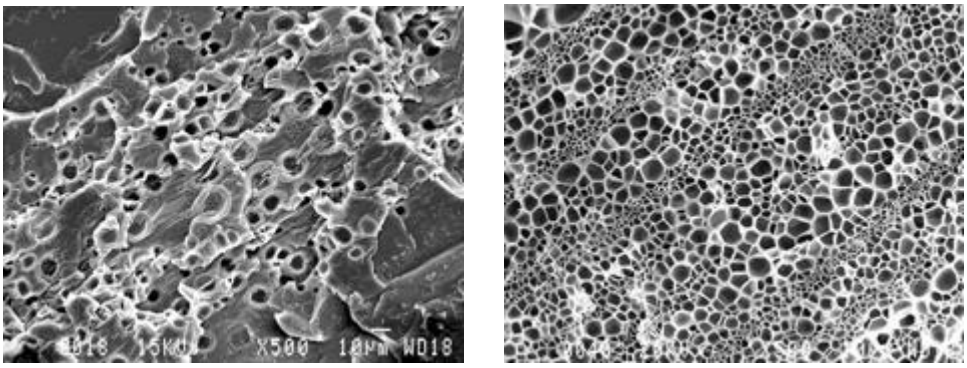
Polystyrene (PS) and syndiotactic polystyrene (sPS) form a miscible blend. PS is amorphous, sPS exhibits complex polymorphism including several ordered– and disordered–crystalline and amorphous forms with or without the meso– or rigid amorphous–phase. In this paper, we report the transport properties in sPS/PS blend–CO_2 system and the generation of layered *and* nano cellular structures in this system. Solubility and diffusivity of CO_2 in sPS/PS blends of composition 25/75, 50/50 and 75/25 wt% was determined at 0 and 35°C. The solubility of in the blends was found to be higher than in the neat polymers due to the higher degree of free volume available in the blends.



Neat PS **Neat sPS**

Figure 1. SEM microphotographs of CO_2 foamed PS and sPS samples saturated at 0°C and 33 atm, foamed at 60°C.

The PS samples saturated with CO_2 at 33 atm, 0°C and subsequently foamed at 60°C exhibited a layered morphology similar to the one reported before and devoid of many cells. sPS samples also did not show a regular cellular structure under similar processing conditions (Figure 1). On the other hand, the sPS/PS (50/50 wt%) blend showed some cellular structure, *albeit* a poor one, at 60°C when saturated with CO_2 at 35°C and 60 atm. However a well defined, fully-developed cellular structure was obtained when the sPS/PS blend was saturated at 0°C with 33 atm of CO_2, and subsequently foamed at 112°C (Figure 2).



(a) **(b)**

Figure 2. SEM microphotographs of CO_2 foamed sPS/PS (50/50 wt%) samples saturated at **(a)** 35°C and 60 atm, foamed at 60°C, **(b)** 0°C and 33 atm, foamed at 112°C.

The latter structure is intriguing as it demonstrates a layered morphology reminiscent of the one observed in PS, and a clear pattern of alternating layers containing small and large cells, with the cells being of uniform size within a given layer. Analysis of the morphologies gave cell sizes of 1.67 microns and 3.68 microns in the smaller and larger regions of the material, respectively. Foaming of the blend of composition 25/75 wt% at 112°C resulted in a collapsed structure, and the blend of composition 75/25 wt% at 112°C resulted in non-uniform cell size in the matrix.