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CO_2- INDUCED REINFORCEMENT OF THE MECHANICAL PROPERTIES IN POLYOLEFIN-BASED NANOCELLULAR FOAMS

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Although various new foam products have been developed, improving cell structure is still important and preferable because the smaller and more uniform cell structure can provide better mechanical properties as well as further reduction of the amount of plastic material. For that purpose, the plastic foams with fine cell structure, so-called microcellular foams which are characterized by cell sizes smaller than 10 μm, have been investigated. At the beginning of microcellular foam researches, it was believed that the foams could be made without sacrificing its mechanical properties or sometime with higher mechanical properties than that of the solid (non-foam) polymer as far as the cell (or bubble) size could be kept uniformly less than 10 microns in diameter. However, that expectation has not yet been achieved even though the superiority of the microcellular foam to conventional foams in dimensional stability was proven. In general, the mechanical property of the foams was deteriorated by foaming or introducing the pores into plastic body. Most of all thermoplastic foams including microcellular foam could not achieve the higher mechanical property, especially, yield stress, than that of the solid. This study shows that reducing the pore size further down to nanometre scale from micrometre scale and increasing the crystallinity by CO_2 could increase the mechanical property higher than that before foaming. CO_2 induced crystallization was utilized during sorption process of batch physical foaming of semi-crystalline polymer. CO_2-induced crystallization occurred during the CO_2 sorption and increased the melting temperature. As a result, the mechanical property especially yield stress was increased by thickening the crystalline lamella. As an example system, Polypropylene (PP) and PP/Hydrogenated Polystyrene-*block*-polybutadiene-*block*-polystyrene (SEBS) blends were foamed with CO_2 after the sorption at a temperature below melting temperature (T_m). CO_2 sorption at temperatures below T_m of the initial PP could make the crystalline lamellae thicker and thus increase T_m from 160 to 178℃. However, the neat PP alone cou ld not be foamed uniformly due to the presence of the crystalline phase although the mechanical property could be successfully increased by CO_2 induced crystallization and cell size reduction. To increase the uniformity of cell structure, SEBS was used. SEBS created highly dispersed domain in PP matrix and provided preferential bubble nucleation sites. As a result, nanocellular foams were obtained while maintaining the yield stress of annealed and foamed samples at higher level than the solid (non-foamed) polymer has.