Toughening of PA 6 by fine dispersed nanosized PA 6-polyether block copolymer particles

Geier Simon, Poindl Marcus

This study focuses on a novel approach of toughening PA 6 by applying an anionic polymerized PA 6 - polyether block copolymer (PA 6 - copo) as an impact modifier. PA 6 / PA 6 - copo blends were prepared by melt compounding using ground PA 6 - copo plates of adjustable polyether soft phase (10 to 40 mass-%) followed by injection moulding of test samples. Mechanical studies show a significant enhancement of the notched Izod impact strength from about 5 to 41 kJ/mm² at a blend with an overall polyether content of 10 mass-%. Moreover it was found that both, the elastic modulus as well as the tensile strength only decreases moderately about 18 and 24 %, respectively. Additionally, phase dispersion and chain mobility were examined by means of dynamic mechanical thermal analysis (DMTA). The occurrence of two characteristic glass transition temperatures indicates the chemical immiscibility of polyether and PA 6 within the copolymer. In case of the blend the retention of this pattern implies the compatibility of PA 6 and PA 6 - copo. AFM reveals fine dispersed soft phases with diameters smaller than 100 nm. Due to the high molecular affinity of both materials no interfacial tensions are recognizable. Furthermore, TEM proves that the original network - like structures of the PA 6 - copo are maintained in the blend. Interference between these structures and the lamella formation of PA 6 was not observed. Lamellae seem to grow through or by the PA 6 - copo soft domains. Finally, the influence of the polyether content of the PA 6 - copo on the toughening effect of PA 6/PA 6 - copo blends was investigated. Here the use of PA6 - copo incorporated 30 mass-% polyether shows the best balance between stiffness and ductile properties of the blends.