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Development of Micro- and Nanostructures in Immiscible PPE/SAN Blends

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The morphology as well as the interfacial properties of immiscible polymer blends are of key importance for the materials performance. In this particular study, both phenomena were analysed in detail for melt-processed blends of poly(2,6-dimethyl-1,4-phenylene ether) (PPE) and poly(styrene-co-acrylonitrile) (SAN). The morphology development, as observed by TEM, was strongly dependent on the blend composition as well as on the viscosity ratio between the constituents. As the highly viscous PPE forms the disperse phase up to contents of 60 wt%, the contribution of the favourable PPE properties to the blend behaviour was observed to be relatively low. In order to reduce the viscosity of PPE and thus to ensure a continuous PPE phase even at low PPE contents, polystyrene (PS) was added as a third blend component since it is selectively miscible with PPE. The detailed rheological and TEM investigation revealed that both the viscosity of the binary PPE/PS phase as well as the subsequent morphology of the ternary (PPE/PS)/SAN blend can be easily controlled by the PS content. Nevertheless, the relatively low interfacial strength and thus poor fracture mechanical behaviour of both the binary as well as the ternary blends necessitate an efficient compatibilisation. The addition of polystyrene-block-polybutadiene-block-poly(methyl methacrylate) triblock terpolymers (SBM) as a compatibiliser led to the development of nanostructured interfaces between PPE and SAN, when appropriately composed. The resulting formation of the so-called 'raspberry morphology' provided an efficient route to ensure significantly improved mechanical properties as demonstrated by tensile properties and the crack fatigue growth behaviour. Subsequently, structure-property-relationship could be established which link the morphological features with the thermal, thermo-mechanical as well as mechanical behaviour of the blend. The morphological control of the micro- and nanostructure development of PPE/SAN blends by the addition of PS and SBM, respectively, opens the door to combine the desirable properties of PPE such as the high heat distortion temperature with advantages of SAN such as the chemical resistance and the high stiffness.