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Polyurethane Elastomers: From Morphology to Mechanical Aspects

Cristina Prisacariu

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A comprehensive account of the physical / mechanical behaviour of polyurethanes (PU´s) elastomers, films and blends of variable crystallinity. Aspects covered include the elasticity and inelasticity of amorphous to crystalline PUs, in relation to their sensitivity to chemical and physical structure. A study is made of how aspects of the constitutive responses of PUs vary with composition: the polyaddition procedure, the hard segment, soft segment and chain extender (diols and diamines) are varied systematically in a large number of systems of model and novel crosslinked andthermoplastic PUs. Results will be related to: microstructural changes, on the basis of evidence from x-ray scattering (SAXS and WAXS), and also dynamic mechanical analyses (DMA), differential scanning calorimetry (DSC) and IR dichroism. Inelastic effects will be investigated also by including quantitative correlations between the magnitude of the Mullins effect and the fractional energy dissipation by hysteresis under cyclic straining, giving common relations approached by all the materials studied. A major structural feature explored is the relationship between the nature of the hard segment (crystallising or not) and that of the soft segments. Crystallinity has been sometimes observed in the commercial PUs hard phase but this is usually limited to only a few percent for most hard segment structures when solidified from the melt. One particular diisocyanate, 4,4'-dibenzyl diisocyanate (DBDI) that, in the presence of suitable chain extenders (diols or diamines), gives rise to significant degrees of crystallinity [i-iii] and this is included in the present work. Understanding the reaction pathways involved, in resolving the subtle morphological evolution at the nanometre level, and capturing mathematically the complex, large-deformation nonlinear viscoelastic mechanical behaviour are assumed to bring new important insights in the world basic research in polyurethanes and towards applied industrial research in this area.

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