Modelling the Constitutive Behaviour of Poly(Ether-Ether-Ketone) for Forming Processes

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Abstract. A constitutive material model suitable for capturing the biaxial deformation response of poly-ether-ether-ketone (PEEK) films is presented. Polymer diaphragms, favored for microspeaker components in portable electronic devices, are typically fabricated through the thermoforming process. During the forming of thin PEEK films, a multi-axial state of stress is imposed when the thermally softened sheet is forced to take the desired shape of the mould. Simulation and optimization of the forming of products are capable through the use of modern computational tools, however can only be performed with accurate knowledge and modelling of the constitutive material response subject to process variables. Previous load and displacement-controlled biaxial testing of specimens at conditions analogous to the forming process highlighted the anisotropic, nonlinear viscoelastic material stress-strain behaviour. The Buckley material model accounts for the temperature and strain rate dependence of the biaxial yield behaviour, and further modified to represent inherent anisotropy within samples. The modelled stress-strain results show that the adapted material model is accurate in reproducing the observed biaxial deformation behaviour of PEEK films, providing future promise as a platform for the development of finite element simulations for the fabrication of micro-speaker components.

Keywords: Poly(ether-ether-ketone), Thermoforming, Constitutive model, Biaxial deformation