Energetic characterization of stretched crystallizing TPU foams by using infrared thermography

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Keywords: Polyurethane, foam, infrared thermography, strain-induced crystallization, energy stored, energy balance

The present study investigates the calorimetric behavior of stretched crystallizing TPU foams. Infrared thermography is first used to measure the temperature variation of samples submitted to quasi-static uniaxial loadings at ambient temperature. Heat sources produced or absorbed by the material due to deformation processes are deduced from the temperature variations by using the heat diffusion equation. Energy balance are carried out over each mechanical cycle to determine the intrinsic dissipation and the amount of energy stored during the cycles. The results obtained show that a significant part of the mechanical energy brought is not dissipated into heat and is stored by the material when the material changes its microstructure, typically when it is crystallizing. Some of this energy is released during unloading, when melting occurs, but with a different rate, which contributes to the hysteresis loop. The part of the mechanical energy stored by the material has been quantified to investigate the effects of the loading rate and the void volume fraction on the energetic response of TPU. These effects cannot be predicted from purely mechanical approaches and the present study provides therefore an experimental framework for a better understanding and modelling TPU foam behavior.