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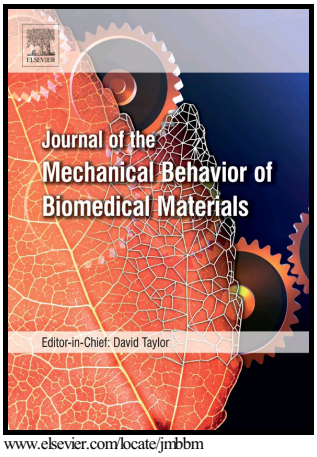

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Mullins effect in polyethylene and its dependency on crystal content: A network alteration model

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Abstract

This contribution is focused on the Mullins effect in polyethylene. An ultra-low-density polyethylene with 0.15 crystal content, a low-density polyethylene with 0.3 crystal content and a high-density polyethylene with 0.72 crystal content are subjected to cyclic stretching over a large strain range. Experimental observations are first reported to examine how the crystal content influences the Mullins effect in polyethylene. It is found that the cyclic stretching is characterized by a stress-softening, a hysteresis and a residual strain, whose amounts depends on the crystal content and the applied strain. A unified viscohyperelastic-viscoelastic-viscoplastic constitutive model is proposed to capture the polyethylene response over a large strain range and its crystal-dependency. The macro-scale polyethylene response is decomposed into two physically distinct sources, a viscoelastic-viscoplastic intermolecular part and a viscohyperelastic network part. The local inelastic deformations of the rubbery amorphous and crystalline phases are considered by means of a micromechanical treatment using the volume fraction concept. Experimentally-based material kinetics are designed by considering the Mullins effect crystal-dependency and are introduced into the constitutive equations to capture the experimental