HIGH STRAIN-RATE RESPONSE OF POLYUREA

Alireza V. Amirkhizi and Sia Nemat-Nasser

UC San Diego
Department of Mechanical and Aerospace Engineering
Center of Excellence for Advanced Materials
9500 Gilman Drive, La Jolla, CA 92093-0416
alireza@starlite.ucsd.edu

We have studied the high strain-rate properties of polyurea, an elastomeric block co-polymer, through experimental and numerical methods. This includes confined and unconfined Hopkinson bar experiments, viscoelastic relaxation measurements at reduced temperatures, and various high-speed tests such as reverse and direct ballistic plate impact. We have developed a constitutive model for polyurea based on time-temperature superposition principle for polymers. The model utilizes the low-temperature relaxation results for high strain-rate viscoelastic shearing of the material at higher temperatures. Along with a non-linearly elastic bulk response, we have been able to successfully reproduce the results of the confined and unconfined Hopkinson bar experiments. This model is incorporated in LS-DYNA, a commercial finite element solver, and used to reproduce the complicated 3D response of polyurea in high-rate loading experiments such as pressure-shear test. Finally we have studied the effect of polyurea as fracture reinforcement for steel in high-rate loadings of metal-elastomer bi-layer plates through numerous experiments and numerical modeling. This collective work allows us to develop a better understanding of the mechanisms responsible for the structural behavior and propose paths to better material and structural design for various applications.

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