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The epoxy resin nanocomposite: Effect of micro-shear bands on mechanical behaviour

Żywica epoksydowa z nanocząsteczkami: wpływ pasm ścinania na własności mechaniczne

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In this paper, the effect of adding graphene nanoparticles with different in terms of weight fractions on the axial mechanical properties of the epoxy matrix is investigated. For this purpose, carbon nanoplatelets (CNPTs) are considered as reinforcement. A simple fabrication process was employed to fabricate epoxy embedded CNPTs, and mechanical properties were studied. Quasi-static and intermediate-low strain rate experiments were performed using a servo-hydraulic MTS 858 axial load frame along with a stainless steel tension/compression tests fixture. A FLIR SC6100 MWIR camera was used to measure the transient surface displacement of the specimens.

A nonlinear phenomenological model is found to be able to describe the elasto-viscoplastic responses of the epoxy embedded CNPTs, and reveal the competition between strain hardening and strain softening which is experimentally evidenced. Finite element (FE) model was developed to validate the predictive results. FE simulations of the conducted experiments were performed with ABAQUS software. In simulations the strain rate dependent modified Perzyna (MP) viscoplasticity model with Mises yield criterion with a strain hardening law was accompanied with micro-shear bands to describe the nanocomposite material properties. The stress and strain distributions for different uniaxial compression and tension considered were calculated using data obtained from the experiments. A range of parameters, like hardening, shear bands evolution, etc.. which play an important role in the simulation, were studied. The results of numerical simulation are compared with those from the experiment obtained. A good agreement between them was achieved.