CMM-SolMech 2022 conference

S08 Nanomaterials and nanocomposites, their properties and applications

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A NEW CONCEPT OF EPOXY RESIN COMPOSITE DOPED WITH CARBON-BASED NANOPARTICLES: MANUFACTURING, EXPERIMENT AND MODELING

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Our studies investigated the elastic-plastic properties and strength of epoxy resin matrices promoted with different concentrations of carbon-based nanomaterials.
Multiwall carbon nanotubes (MWCNT) and graphene nanopowder xGNP-M-5 (XG Science), in the manufacture of epoxy L20/graphene composites, specific amounts of resin were mixed with hardener and graphene and oxidized graphene in 0.1, 0.5, 1, 2.4% by weight, prepared. The resulting mixtures were degassed under vacuum (-1 bar) and poured into silicone molds. The composites were left in the fume hood to cure for 24 hours and then heated at 120°C for 96 hours. A similar procedure was used for the fabrication of MWCNT/Resin composite.
The mechanical response of epoxy networks was investigated under uniaxial tension and compression at low strain rates, using the MTS 858 testing machine and the DIC (Digital Image Correlation) technique. In the quasi-static uniaxial compression tests, cylindrical specimens with the dimension ratio of 1.5: 1 (height: diameter) were used. In the axial tensile tests, flat samples cut from lamellas with a thickness of 1 mm were used. The actual stresses and actual strains were determined, assuming the incompressibility of the material. The tests were carried out on at least three samples for each type of epoxy graphene composites. Young's modulus was determined for the linear part of the stress-strain relationship for strains ranging from 0.1 to 0.3%. The resin's deterioration process results from developing a multiscale micro-shear bands system leading to inelastic strains terminated by cracking in samples with deformation of 4% resulting in a sharp drop in stress. Based on these observations, a model describing the inelastic behavior of nanocomposite was proposed, modifying the viscoplastic flow equation by introducing the shear banding contribution function.