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Abstract: The heat transfer, gas diffusion process and thermomechanical deformation are generally coupled and associated with the chemical decomposition for fiber reinforced polymer composites at elevated temperatures. The three-dimensional (3-D) governing differential equations for the coupled temperature-diffusion-deformation problem of porous elastomers were developed. The thermomechanical behavior of a silica/phenolic composite material was predicted using the mathematical model. The spatially dependent temperature and pore pressure, displacement, and stress contours of silica/phenolic composites exposed to one-sided radiant heat flux were investigated. Based on the digital image correlation technique, a non-contact high temperature deformation measurement test was conducted. The temperature profiles were measured by the thermocouples embedded in different depths of the specimen, while the full-field displacements and strains were provided by correlating the two digital images of the specimen surface in the un-deformed and deformed states, respectively. The accuracy of the proposed model was assessed by comparing the predicted temperatures and displacements with experimental values for the same boundary and initial conditions.

Keywords: Polymer-matrix composites; Thermomechanical behavior; High temperature deformation;