Inverse Identification of Damage Properties of Graphite Material Based on Experimental and Simulation Analysis

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Abstract: Nuclear graphite is a key material in high temperature gas-cooled reactors. The evaluation of its damage evolution is of great importance for safety assessment of nuclear graphite structures. However, the damage properties of nuclear graphite are difficult to characterize by the traditional testing approaches, i.e., uniaxial tension and compression tests due to the inconvenience of conducting uniaxial tension/compression tests. In this paper, an inverse method was developed to identify the damage parameters of a nuclear graphite material IG11. The method is based on the non-contact digital image correlation and finite element model updating techniques, and damage-induced nonlinear stress-strain curves for both tension and compression were obtained simultaneously by using just one test. In order to improve the inverse identification efficiency, a double iterative technique was employed with the aid of an optimization algorithm. Verification of the inverse method was carried out by simulated tests and rapid convergence with good accuracy was achieved. The results showed that the nuclear graphite material exhibits distinct damage evolution behaviors under tensile and compressive loading, with more serious damage for the former at the same strain level.

Keywords: Nuclear graphite; damage; digital image correlation; finite element model updating; inverse optimisation algorithm

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