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PROCEEDINGS

An Experiment-Simulation Method for the Determination of the Mode-II Critical Energy Release Rate

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ABSTRACT

To overcome the harsh experimental conditions of determining the mode-II critical energy release rate G_{IIC}, a flexible experiment-simulation method for determining G_{IIC} is proposed based on the mixed-mode fracture experiments and the corresponding simulations by the mixed-mode phase-field model. In details, a mixed-mode fracture experiment is first conducted to obtain the initial crack deflection angle. Subsequently, a series of phase-field simulations are conducted by altering the value of G_{IC}/G_{IIC} to reproduce the experimental result so as to determine the value of G_{IIC} with a known G_{IC}. Three mixed-mode fracture tests (single edge cracked circular test, central crack rectangular tension test and compact tension shear test) of PMMA indicate that the determined G_{IIC} is a stable material parameter independent of test and loading conditions. Meanwhile, the determined prediction of G_{IIC} is compared with those in other references with a deviation of about 3.5%, which demonstrates that the proposed method can quantitatively and qualitatively obtain G_{IIC}. Furthermore, the determined parameter G_{IIC} is used to develop the mixed-mode phase-field model through using the mode-mixity factor (G_{IC}/G_{IIC}) to regular the relative contribution of the volumetric and distortional crack driving energy. As a result, the mixed-mode phase-field model provides better simulations than the classical phase-field model for the materials with large difference between G_{IC} and G_{IIC}. Without the harsh conditions of the pure mode-II fracture, the proposed method is of significant practice in the determination of G_{IIC}, which benefits the study of mixed-mode fracture problems.

KEYWORDS

Mode-II critical energy release rate; experiment-simulation method; mixed-mode phase-field model; mode-mixity factor

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