Fracture Dynamics-A Photomechanics Investigation

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This presentation will summarize the author's studies on dynamic fracture based on photomechanics. During the early stage of our studies, dynamic photoelasticity was used to record dynamic crack propagation/arrest and crack branching in Homalite-100 fracture specimens. Dynamic crack arrest was found to be a constant but significantly higher than the ring down static arrest stress intensity factor which varies with the crack initiation condition. A crack branching criterion based on a critical stress intensity factor was also established. Moiré interferometry together with high-speed photography and the generation phase of dynamic finite element analysis were then used to determine the dynamic fracture toughness of 7075-T6 and 2024-T3 aluminum specimens. A high temperature moiré interferometry was developed and the fracture toughness at temperature up to 1000° C was recorded in alumina fracture specimens. A two-dimension finite element (FE) models with postulated grain/fiber bridging models in the fracture process zone of ceramic matrix composite were used to estimate the energy dissipated during fracture. Postulated crack bridging models were adjusted through an inverse analysis to match the computed crack opening displacement (COD) with the measured surface COD via moiré interferometry. Fracture behavior of carbon fiber/carbon matrix (C/C) composite was analyzed with an equivalent 2-D finite element (FE) model of a single edged notch bend (SENB) specimen subjected to a series of re-notching tests. An idealized distribution of crack bridging stress (CBS) along an idealized straight crack was obtained through an inverse analysis by matching the FE computed and moiré measured crack opening displacement (COD) during the re-notching process. This FE model was used to estimate the equivalent strain energy release rate, G_{eq}, and the equivalent stress intensity factor, K_{eq}, of the zig-zagged crack.

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