The Influence of Biaxial Strain Ratio and Strain Range on Crack Growth Mode and Crack Shape

T. H. Topper(1), J.J.F. Bonnen(2), M. Khalil(3), and A. Varvani-Farahani(4)

(1)Department of Civil and Environmental Engineering University of Waterloo, Canada (topper@uwaterloo.ca)

(2)Materials Science Dept., Ford Research and Innovation Center, Dearborn, MI, USA (john.bonnen@gmail.com)

(3)Bombardier, Toronto, Canada (mohamed.khalil1@gmail.com)

(4)Department of Mechanical Engineering Ryerson University (avarvani@ryerson.ca)

Abstract

Axial- torsion tests were used to determine and model the combinations of strain range and crack length at which the crack growth changed from shear to tensile mode. Biaxial tests and confocal scanning laser microscopy (CSLM) were used to observe crack shape evolution at various strain ratios. Constant and variable amplitude loading of notched specimens and CSLM were used to determine the dependence of crack shape development on strain range. The results showed that, except for very high strain levels, at strain ratios causing shear mode crack growth multiple cracks initiated and grew until they were semicircular and then linked up to cause failure. For tensile mode crack growth at low strains a single crack grew into and maintained a semicircular shape. At high strain ranges multiple cracks formed and linked up to maintain an elongated crack shape.