

Use of Cube-Corner Nano-indentation Crack Length Measurements to Estimate Residual Stresses Over Small Spatial Dimensions

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Abstract:

Cube-corner indenters, by virtue of their acuity, possess a lowered threshold load for cracking. Shorter crack lengths allow the sampling of residual stresses in small spatial dimensions. We conducted cube-corner indentation on tempered and annealed glasses. The geometry of the cracks was found to be “quarter-penny”, with three cracks at each indentation site. An approximate stress-intensity factor for this geometry was written using a weight function approach. Crack length decrements on tempered materials were used in a stress-intensity superposition to provide reasonable estimates of residual stress. Stresses ~100 MPa over a length scale of 10 μm , and 30 MPa over 20 μm were measured accurately, indicating that cube-corner indentation is a promising tool for materials characterization. We describe recent examples of the use of the technique to aid in component development of two different glass-to-metals seals.

Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract-DE-AC04-94AL85000.

