Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Do Plastic Zones form at Crack Tips in Silicate Glasses? SHELDON WIEDERHORN, THEO FETT, JEAN-PIERRE GUIN — In a number of recent studies, the claim has been made that silicate glasses fracture by the formation, growth and coalescence of cavities, in the same way as in metals but at a much smaller scale. Evidence for this premise is based on the examination of side surfaces of fracture mechanics specimens, at the point where the crack intersects the free surface. Such measurements were carried out with an atomic force microscope, which demonstrated finite depressions in the regions around and in front of crack tips in silicate glasses. The height profile around crack tips supposedly differed from that obtained from a simple linear elastic fracture mechanics analysis; while, in front of the crack tip small depressions were observed which were interpreted as cavities. We used a three-dimensional finite element analysis to show that the calculated depression around the crack tip is in excellent agreement with that obtained by atomic force microscopy. In addition, we used AFM measurements on the fracture surfaces themselves to demonstrate the absence of the kind of residual damage that should be present on fracture surfaces if cavitation occurred at crack tips in glass. Our results are proof that cracks in glass propagate by brittle fracture; glass is elastic and bond snapping is the dominant feature of crack growth.

Sheldon Wiederhorn

Date submitted: 25 Nov 2006 Electronic form version 1.4