CENTER FOR MATERIALS PROCESSING AND TRIBOLOGY DISTINGUISHED SEMINAR

High-speed photographic studies of dynamic fracture of brittle materials

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Abstract

Results from high-speed photographic studies carried out at framing rates of up to 2 million frames per second of the impact damage of brittle materials, such as the silicate glasses, simple ionic crystals and an epoxy resin will be described. Both spherical and conical projectiles were used. The spheres were up to 2 mm in diameter and the tungsten carbide cones were of an included angle of 90^{o} and a base diameter of 1mm. The projectile velocities were upto 300 m/s and both normal and oblique impacts were employed. It was found that under the above impact conditions damage in the target material comprising cone cracks, median cracks and lateral cracks occurred within the projectile and target contact time, which was of the order of 1-2 μs. The impact-generated cracks reached high velocities, but no crack bifurcation was observed in such cracks. Effects of thermal tempering of soda-lime glass on the nature of the impact-generated damage will be shown.

Low-velocity impact cracking of 12.7 mm diameter acrylic spheres was also studied by viewing the damage formation and propagation along two directions, one at 90^{o} to the impact axis and the other along the load axis. It was thus possible to identify the points of initiation of the damage and its nature.

Several typical photographic sequences will be shown and discussed. A brief overview of history of high speed photography research at the Cavendish will also be presented.

Bio sketch

Munawar Chaudhri is a Reader (Emeritus) in Physics at the Cavendish Laboratory, University of Cambridge, UK and an Official Fellow of Darwin College, Cambridge. He received his B.Sc. (Honours) and M.Sc. (Physics) from the University of Punjab, Lahore, Pakistan. He received his Ph.D. (Physics) in 1970 from the University of Cambridge. Munawar Chaudhri has been at the Cavendish laboratory since 1966 and his research interests are in the studies of very fast phenomena, such as impact, fracture and explosions, using high-speed framing photography at rates of up to 10 million frames per second. His other areas of current interest are: (1) indentation hardness and nano-hardness of solids, and (2) effects of high hydrostatic pressures on electrical, optical and structural phase transition properties of solids.

Refreshments at 1045 AM

Additional information from S. Chandrasekar (chandy@ purdue.edu)