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Ultra-high-speed X-ray imaging of shock-induced cavity collapse in a solid medium E M ESCAURIZA, D J CHAPMAN, Department of Engineering Science, University of Oxford, J P DUARTE, Institute of Shock Physics, Imperial College London, J C JONSSON, L FARBANIEC, M E RUTHERFORD , L C SMITH, Department of Engineering Science, University of Oxford, M P OLBINADO, A RACK, ESRF, D E EAKINS, Department of Engineering Science, University of Oxford — The phenomenon of cavity collapse has long been of interest because of the dramatic and highly localised increases in pressure and temperature that can occur during the collapse process. Due to the constraints imposed by optical imaging systems, such as refractive effects of the cavity medium and low image resolution, existing experimental work has largely been limited to cylindrical cavities in transparent liquid and gel media. We present an ultra-high-speed synchrotron X-ray imaging study of the shock-induced collapse of spherical cavities in PMMA, performed at beamline ID19 of the European Synchrotron Radiation Facility (ESRF). A multi-camera imaging system allowed multiple radiographs to be captured per event, revealing the time evolution of sub-surface structures during collapse, such as jet, toroid and crack formation. Shock states were achieved through plate impact experiments, using both a single-stage and two-stage gas gun, generating a wide range of shock pressures between 0.5 and 17 GPa. A transition from strength-dominated to fluid-dominated dynamics was observed, and the data suggest a hard transition occurs at approximate 2 GPa, which is in agreement with previous experiments on the shock response of PMMA.

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