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Shock Compression Spectroscopy of Quantum Dots[1] JAMES CHRISTENSEN, ALEXANDR BANISHEV, DANA DLOTT, University of Illinois at Urbana Champaign — We have investigated CdSe quantum dots (QDs) as photoluminescent probes of shocked solids. They could be especially useful for composite materials, where the individual components could be tagged with different color QDs. The QDs are tiny (4 nm) spherical emitters, pumped by a continuous laser during shock or diamond anvil experiments up to 12 GPa. In the diamond anvil the QDs are hydrostatically compressed and the emission blueshifts with increasing pressure. By contrast, in shock experiments the QDs are embedded in a hard glass or a soft polymer matrix and subjected to uniaxial compression, which should mechanically deform them, and the emission redshifts with increasing pressure. We did hundreds of shock experiments with laser-driven flyer plates, measuring time-resolved intensities, spectral shifts and spectral widths with 1 ns time resolution. We also measured the time-dependent strain of the matrix using a fast optomechanical probe. We showed that the QD redshift can measure the strain in the glass or polymer with 1 ns time resolution. In the hard glass above 4 GPa the QDs behave oddly. When the shock arrives, the QDs redshift as the strain increases, but after about 20 ns, the redshift disappears for about 20 ns and then reappears. We think this redshift blinking behavior is related to the shear transients in the matrix, which suggests we might be able to use QDs to measure uniaxial strain and shear.

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