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Shocked reactions: the first half nanosecond

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Ultrafast laser techniques allow resolution of shock induced physics and chemistry picoseconds behind the shock front. We combine 300 ps sustained laser-generated shocks with ultrafast dynamic ellipsometry to measure the shock state and transient absorption to measure the molecular electronic response to shock loading. Additional nonlinear spectroscopic probes offer the potential to measure even more details of the molecular shock response, such as vibrational temperature and evolution of chemical species. Experimental data will be presented on shocked explosive crystals and liquids. Explosive crystals are studied for the relevance to shock initiation processes. A range of simple molecular liquids is being studied to map out shock reactivity as a function of systematic variations in bonding. The relation of the ultrafast laser data to molecular dynamics simulations and large scale gas gun work will be discussed with an emphasis on what the synthesized information can tell us about shock induced chemical reactions across this broad range of length and time scales.