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Study of the laser-induced decomposition of energetic materials at static high-pressure by time-resolved absorption spectroscopy
PHILIPPE HEBERT, CHARLES SAINT-AMANS, CEA DAM Le Ripault, BP16, 37260 MONTS, France — A detailed description of the reaction rates and mechanisms occurring in shock-induced decomposition of condensed explosives is very important to improve the predictive capabilities of shock-to-detonation transition models. However, direct measurements of such experimental data are difficult to perform during detonation experiments. By coupling pulsed laser ignition of an explosive in a diamond anvil cell (DAC) with time-resolved streak camera recording of transmitted light, it is possible to make direct observations of deflagration phenomena at detonation pressure. We have developed an experimental set-up that allows combustion front propagation rates and time-resolved absorption spectroscopy measurements. The decomposition reactions are initiated using a nanosecond YAG laser and their kinetics is followed by time-resolved absorption spectroscopy. The results obtained for two explosives, nitromethane (NM) and HMX are presented in this paper. For NM, a change in reactivity is clearly seen around 25 GPa. Below this pressure, the reaction products are essentially carbon residues whereas at higher pressure, a transient absorption feature is first observed and is followed by the formation of a white amorphous product. For HMX, the evolution of the absorption as a function of time indicates a multi-step reaction mechanism which is found to depend on both the initial pressure and the laser fluence.

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