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Benchtop Energetics: Detection of hyperthermal species EMILY FOSSUM, CHRISTOPHER MOLEK, WILLIAM LEWIS, MARIO FAJARDO, U.S. Air Force Research Lab — We present an apparatus designed for investigating reacting small-scale energetic materials. In the test setup, sub-mg explosive samples are initiated under vacuum, where the expansion effectively quenches the reaction, preserving the intermediates for mass spectrometric analysis. It is known that the expansion of a detonation wave into vacuum produces hyperthermal molecular species, with leading-edge velocities in excess of $\sim$10 km/s. An important step, therefore, is to demonstrate our ability to detect such fast species and distinguish them from slow species resulting from deflagration. The time between the initiation and the arrival of species at the detection region provides a metric for determining molecular velocity; however, the instrumental sensitivity is influenced by the velocity of incoming species, and thus a thorough investigation of the sensitivity and limits of the instrumentation is essential. Laser-ablated aluminum provides simple source of fast atoms; we compare experimental results with SIMION calculations, to determine a velocity-dependent "instrument transfer function." We also present mass spectra of energetic materials subjected to direct-laser-irradiation; products ranged in velocity from 2 km/s to $>$ 10 km/s, depending on initiation conditions. These results provide steps toward a chemically-based diagnostic for distinguishing between detonation and deflagration events.

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