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Time-Of-Flight Mass Spectrometry of Laser Exploding Foil Initiated PETN Samples

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We report the results of time-of-flight mass spectrometry (TOFMS) measurements of the gaseous products of thin film PETN samples reacting *in-vacuo*. The PETN sample spots are produced by masked physical vapor deposition of PETN [A.S. Tappan, *et al.*, AIP Conf. Proc. **1426**, 677 (2012)] onto a first-surface aluminum mirror. A pulsed laser beam imaged through the soda lime glass mirror substrate converts the aluminum layer into a high-temperature high-pressure plasma which initiates chemical reactions in the overlying PETN sample. We had previously proposed [E.C. Fossum, *et al.*, AIP Conf. Proc. **1426**, 235 (2012)] to exploit differences in gaseous product chemical identities and molecular velocities to provide a chemically-based diagnostic for distinguishing between "detonation-like" and deflagration responses. Briefly: we expect in-vacuum detonations to produce hyperthermal (v $\sim$ 10 km/s) thermodynamically-stable products such as N_2, CO_2, and H_2O, and for deflagrations to produce mostly reaction intermediates, such as NO and NO_2, with much slower molecular velocities – consistent with the expansion-quenched thermal decomposition of PETN. We observe primarily slow reaction intermediates (NO_2, CH_2NO_3) at low laser pulse energies, the appearance of NO at intermediate laser pulse energies, and the appearance of hyperthemal CO/N_2 at mass 28 amu at the highest laser pulse energies. However, these results are somewhat ambiguous, as the NO, NO_2, and CH_2NO_3 intermediates persist and all species become hyperthermal at the higher laser pulse energies. Also, the purported CO/N_2 signal at 28 amu may be contaminated by silicon ablated from the glass mirror substrate. We plan to mitigate these problems in future experiments by adopting the "Buelow" sample configuration which employs an intermediate foil barrier to shield the energetic material from the laser and the laser driven plasma [S.J. Buelow, *et al.*, AIP Conf. Proc. **706**, 1377 (2003)]. [RW PA#4930]