High Pressure Boron Ignition and Combustion

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Abstract: The high potential energy release of **boron** makes it a prime candidate for a high enthalpy fuel or as a fuel additive to solid propellant formulations, as well as a prospective additive for tailoring energy release rates of explosive grains. The problem of long ignition delays at atmospheric and lower pressures, caused by a combination of factors which include the necessity to remove a combustion-retarding oxide layer from the particles, a high vaporization temperature for the pure **boron** substrate, and slow condensation kinetics, have generally precluded the use of **boron** for energetic fuel applications at these pressures. This report summarizes experiments which measure an order of magnitude shorter ignition delays than previously published 1 atm data, for pure and reduced oxygen and oxygen mixtures with water vapor and fluorine compounds (H, HF) over 8.5 to 34 atm and 2000 to 3000 K. Ignition delays in the 300 to 500 microsecond range are observed in a shock tube, decreasing with increasing temperature, and increasing twofold when oxygen concentrations are reduced to 5% in Ar. Fluorine, from dissociated 1% SF6 in O2, is seen to decrease ignition delays by a factor of 1.7 compared to pure oxygen. A combustion chamber is used at a peak pressure of 157 atm and temperature in excess of 2800 K to study ignition delays at higher pressures than are possible in the shock tube. Endwall emission spectra of BO2 are recorded for comparison with **boron** ignition models.

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