

Combustion of Boron Powders Through Bunsen Flame

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Abstract

IN the present work, an attempt has been made to investigate the combustion of the boron powders passing through a premixed flame which is intended to simulate, as closely as possible, the local conditions which may arise in a real combustor of an air augmented rocket.

Contents

Boron powders, having average diameters of 0.9 and 15 μm , are fed through a conventional Bunsen burner at atmospheric pressure, and the temperature fields and the variation of the burning velocity are measured. The premixed gases, blended with methane, hydrogen, oxygen, and nitrogen, are introduced into the burner. The mixture compositions were arbitrarily selected so as to sustain the premixed flame stabilization. The experiments were carried out for the equivalence ratio Φ_g in the range from 0.5 to 1.2.

Figure 1 shows the temperature distributions across the premixed flame at 6 mm above the burner rim which is at approximately half height of the flame cone. The data show that the addition of the boron powders substantially reduces the flame temperature. In the Macek data quoted in Ref. 1, the ignition delay for the 17.5 and 22 μm particles lies in the range of about 4-6 ms, while in the present experiment the residence time of the particles in the premixed flame is estimated to be about 2 ms. Therefore, the particles may not be able to ignite in the flame.

Figure 2 shows the variation of the burning velocity of the premixed flame with ρ_s , density of boron powders in unit volume. Notice that the burning velocity considerably decreases as ρ_s increases, a trend which is appreciable for small particle size. This feature is qualitatively identical with the results of Mitani's flame inhibition theory.²

It is suggested that the boron powders do not contribute to the gas phase reaction in a premixed flame, acting instead merely as a heat sink.

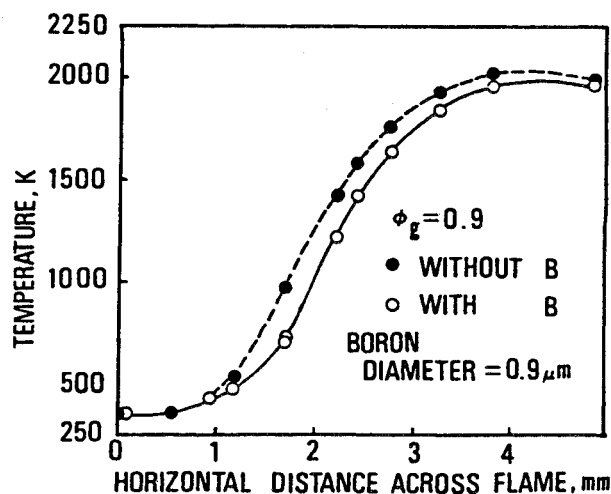


Fig. 1 Flame temperature across premixed flame.

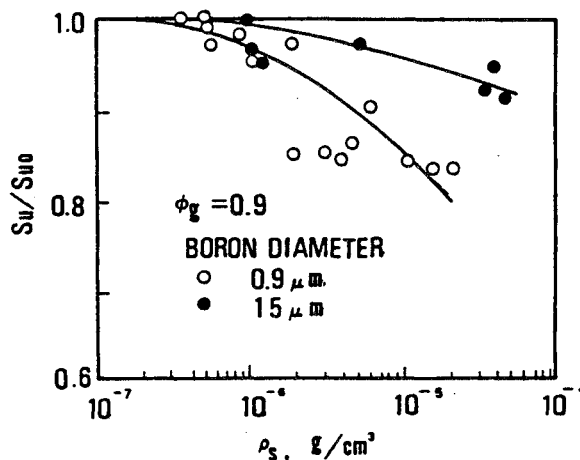


Fig. 2 Variation of burning velocity of premixed flame.

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