Burning times of boron, aluminum diboride and aluminum dodecaboride microparticles

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The commonly used tools for studying the combustion of metal fuel particles, including boron, are gas burners [1–2]. This paper presents an original experimental set up that also includes a gas burner. However, our technique has a number of features that give advantages over others, namely, preheating the gas mixture up to a temperature of 600 K and creating a combustion environment with high oxygen content, introducing the tested particles into the flame directly with a working premixed combustible gas mixture (no carrier stream of inert gas). These features make it possible to create combustion conditions that simulate conditions in a technical device. Gas flame parameters are calculated using the ChemKin software. The sampling of combustion product particles is performed immediately after the flame using AQFA-type filters made of quartz fiber. The use of laser illumination and video shooting at 3200 fps allow us to record streaks of moving particles, both burning (behind the flame front) and cold (without flame). As a result of the analysis of the streaks, the burning times of the micron size particles of boron, aluminum and aluminum borides were determined. A modified mathematical model of boron particles combustion was developed based on the PSU (Pennsylvania State University) model [3]. Verification of model was carried out using burning times measured in the experiments.

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