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MICRO FLAME SPREADING IN SOLID FUEL DUCTS

Abstract

Recently, a novel type of flame called a 'micro flame' has been found and studied because of its anomalous properties. It has been know that micro flame is formed when the Reynolds number = O (1 to 2) and Froudes number >> 1 by using a Bunsen burner. Micro flame is a diffusion flame observed under normal a gravitational field; however, the form becomes small-spherical, which is analogous to flame under micro gravitational field. This is because the buoyancy force due to gravity becomes negligible compared to forced convection. Because of the micro flame's exhibited pseudo-microgravity behavior, it is expected to be an alternate method for micro gravitational experiments. As energy from combustion is greater than electrical energy, micro flame could be expected to be a small size and high output energy source for such applications as micro-electromechanical system (MEMS). Though micro flame studies have been conducted previously, they have been limited to the investigation of the conditions, properties, and mechanisms of steady (non-dynamic) micro flames created using a Bunsen burner. Dynamic micro flames created by flame spreading have not previously been characterized.

We have found micro flames could be formed within the flame spreading region of solid fuel ducts. In this study, we investigated the conditions and properties of the non-steady (i.e. dynamic) micro flames. These micro flames form and propagate even when the Reynolds number is more than 100 for the flame spreading in the solid fuel ducts. It is believed that in this instance, the effects of heat transfer becomes larger than for the Bunsen burner, since the directions of the diffusion of mass and heat is confined. As the effect of gravity is very small, micro flame spreading is different from normal flame spreading. For example, travelling velocity is much lower and the form of the flame becomes small-spherical. Although there are several different kinds of flame spreading in fuel ducts, such as the chemical regime, thermal regime, and stabilized regime, these results suggest that micro flame is a novel kind of flame spreading.