

Flame Spread of N-Decane Droplet Array with Pre-Evaporation in Microgravity

Masao KIKUCHI¹, Shin YAMAMOTO¹, Shinichi YODA¹ and Masato MIKAMI²

¹ Japan Aerospace Exploration Agency, Tsukuba, Japan, kikuchi.masao@jaxa.jp

² Yamaguchi University, Ube, Japan, mmikami@yamaguchi-u.ac.jp

Abstract

Flame spread phenomena of linear n-decane droplet array are investigated by microgravity experiments and numerical analysis. Especially, pre-evaporation effects of droplets on flame spread process are examined in this study. In microgravity experiments, each droplet which consists of the array is formed and sustained at intersections of fine, X-shaped SiC fibers of 14 micrometer diameter. Activation delay time of the igniter wire after insert of the array into the combustion chamber, t_w , is employed as primary experimental parameter to control the degree of pre-evaporation of the array. Experiments are performed with some different droplet diameter (d_0) and droplet interval (S) at ambient air with $T = 600$ K. Experimental results showed development of blue flame at spreading flame front with enhancement of pre-evaporation. Also, OH radical emission showed characteristic shape at flame front region when pre-evaporation of droplets are developed. Flame spread rate V_f increased with increase in the degree of pre-evaporation. However, V_f appears to approach some value with further pre-evaporation. In addition, numerical results showed similar characteristic flame structure at flame front as experimental results. It was suggested the flame front has a structure like a triple flame.