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EXPERIMENTAL STUDY ON THE INFLUENCE OF DIFFERENT OSCILLATION AMPLITUDE ON THE COMBUSTION CHARACTERISTICS OF PROPELLANT ALUMINUM PARTICLES

Abstract

As one of the basic components of solid composite propellant, the addition of aluminum can improve the specific impulse, combustion temperature and inhibit the combustion instability of propellant. The deformation of aluminum particles under the effect of oscillating environment changes the combustion process on the propellant surface and near the surface, changing the distributed combustion and particle size distribution of aluminum particles simultaneously.It is noteworthy that distributed combustion may be the gain factor of combustion instability, and the particle size distribution of aluminum particles determines the particle damping of combustion instability. Consequently, the study of the combustion characteristics of aluminum particles in oscillating environment is of great significance to the study of combustion instability. In order to obtain the accurate diagnosis results and the dynamic characteristics of aluminum particle combustion in the oscillating environment, experimental apparatus and measurements were built in this study which adopted the synchronous optical diagnosis method of high-speed photomicrography and digital in-line holography(DIH).The dynamic combustion characteristics of aluminum particles in a aluminized AP/HTPB composite propellant (aluminum powder content is 18% and initial particle size is about 29um) were experimentally investigated and compared with the experimental results under the non-oscillation environment. The results of comparison of non-oscillation environment and oscillation environment with frequency of 340Hz and amplitude of 250Pa suggest that the oscillation environment makes aluminum agglomerated particles more prone to deformation, reduces the retention time of small-size aluminum agglomerated particles on the burning surface. In consequence, the probability of secondary fusion of aluminum agglomerated particles increases (from 40.91% to 55.41%).The oscillation environment can promote the agglomeration of aluminum particles. Under the oscillation environment, the mass average particle size (D43) of aluminum particles increases by 28.98%, the average agglomerated particle size (Dagg) increases by 27.75%, and the agglomeration fraction increases by 1.24%. The experimental research has been carried out for the same propellant under the oscillation frequency of 340Hz but different oscillation amplitudes, and the original experimental results under different oscillation amplitudes have been acquired. Subsequently, the influence laws of different oscillation amplitudes on the

deformation, retention time and particle size distribution of aluminum particles will be further analyzed and captured.