Paper ID: 19367
oral

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advancements in Materials Applications and Rapid Prototyping (9)

Author: Mr. Chen Tao
The 42nd Institute of the Fourth Academy, China Aerospace Science and Technology Corporation (CASC), China, chta2008@163.com

Prof. Xiao Jin-wu
China, xiaojw_006@sina.com
Mr. Zhang Xian-rui
China, zhangxr42@163.com
Mrs. Wang Yuan-yuan
China, wangyy2013@163.com

EFFECT OF LIF COATING ON THE THERMAL OXIDATION CHARACTERISTICS FOR BORON PARTICLES

Abstract

Boron fuel was the first choice for fuel-rich propellant due to its high gravimetric heat and volumetric heat, however, boron-based fuel-rich propellant was restricted to its practical use as a result of low combustion efficiency of boron. Intensive and effective work had been carried out on the surface treatment of boron since late 1980s, it was founded out that LiF coating can accelerate the surface oxide removal process and improve the combustion properties of boron, but researches on the effect of LiF coating on the thermal oxidation characteristics for boron particles remained undone. In order to disclose the effect of LiF coating on the thermal oxidation mechanism for amorphous boron powder, boron coated with LiF(BLiF) was investigated by means of DSC-TG. Propellant samples containing BLiF were prepared, then the heat of explosion and heat of combustion were determined by oxygen bomb calorimeter and the energy release features during the primary combustion and after-burning processes were discussed. The experimental results indicated that BLiF showed an accelerated oxidation reaction at a lower temperature(599), and a remarkably lower total weight loss(62.8 percent) ranging from room temperature to 1700 compared with that of amorphous boron. Based on experimental results and thermodynamic analysis, it revealed that the thermal oxidation mechanism of the BLiF depended on the critical temperature(1626K). Below 1626K, LiF and melted B2O3 can form a eutectic product, which leaded to the destruction of compact three-dimensional network and the decreasing of viscosity of of B2O3. As a result, the diffusion of O2 across the melted B2O3 layer was boosted and the reaction between boron powder and O2 was promoted. Chemical reaction between LiF(l) and B2O3(l) occurred when it reached the critical temperature 1626K. This reaction consumed the melted B2O3 layer and accelerated the B/O reaction. Energy releasing efficiency of primary combustion and after-burning(c1 and c2) of propellant containing BLiF were increased notably, especially the combustion efficiency of boron(B) was increased significantly from 65.48