Analysis of dynamic behaviors of HMX/GAP/Al aluminized solid propellant combustion using moving boundary method

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The rigorous mathematical model (mass, momentum and energy conservation) was developed for three phases including solid phase, condensed phase and gas phase with a detailed kinetic including 507 gas phase reactions and 4 condensed phase reactions of HMX/GAP/Al combustion. Based on this model, the dynamic simulation was carried out by using moving boundary approach with gPROMS software. This research described influence of nano-sized aluminum on combustion behaviors of composite rocket propellant HMX/Al/GAP such as burning rate, temperature, mole fraction of species and specific impulse. The analysis of dynamic behaviors was conducted based on case studies for Al contents in initial propellant mixture and operating pressure. The model and simulation predicted the gas phase temperature of 3061 K for HMX/GAP/Al propellant containing 20 wt.% Al, the specific impulse of 258.53 s for HMX/GAP/Al propellant containing 15 wt. % Al under an operating pressure of 100 atm. From this study, the addition of aluminum particles with content around 15-20 wt. % improved combustion behaviors considerably.