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STUDY OF DUAL-CATALYTIC BED SCALE-UP PARAMETERS FOR HIGH TEST HYDROGEN PEROXIDE THRUSTERS

Abstract

High Test Hydrogen Peroxide is one of the green propellant candidates for replacing high toxic propellants such as hydrazine and its derivatives. Due to its easy handling, many small scale hydrogen peroxide thruster systems are being developed. Dual-catalytic bed using different grain sizes and catalyst types have been widely adopted in hydrazine monopropellant thruster's catalyst beds. Usually, the small catalyst grains are placed in the upper bed, whereas the larger catalyst grains are placed in the lower bed. The Dual-catalytic bed which uses two different grain sizes has several advantages for thruster performances. As a thrust level becomes higher, it causes the high-pressure drop across the catalyst bed. We adopted dual-catalytic bed for 2500 N class hydrogen peroxide bi-propellant thruster to solve the high-pressure drop. The high-pressure drop was successfully decreased. In this reason, dual-catalytic bed scale-up study is needed for the high thrust level application like the sounding rocket, launch vehicle. In this study, we investigated the influence of scale-up parameters to the pressure drop across the catalyst bed. The scale up parameters are aspect ratio of the catalyst bed, mass flux, catalyst capacity and etc. According to the Heo et al.'s and Yun et al.'s dual catalytic bed firing tests, the pressure drop of two different scale of catalyst beds seems to be identical when the mass flux and aspect ratio are same as different scale's. To make sure of this assumption, we estimated the influences to the pressure drop according to the scale-up parameters using the dual-catalytic bed model. The model was validated in the previous study. As a result, when the mass flux and length of the catalyst bed are same as the different scale's, pressure drop of two different scale bed is identical. Dual-catalytic bed thruster firing tests will be conducted to validate the model estimation of the scale-up parameter influences. Two sizes of catalyst beds which have the same aspect ratio, 0.58, will be used. Smaller one's diameter and length is 45.8 * 26.7 mm. Larger one's is 80 mm * 47 mm. The volume ratio of two different grain sizes in packed bed and propellant mass flux will be controlled. $MnO_2/PbO/Al_2O_3$ catalysts will be used. The catalyst bed will be composed of 10-16 mesh grain and 1/8 inch pellet. Pressure and temperature in the bed will be measured 5 points each along the axis to analyze the pressure drop across the catalyst bed.