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Experimental Analysis of Hydrogen Peroxide Film-cooling Method for Nontoxic Hypergolic Thruster

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Abstract

The present study focused on experimental studies on the hydrogen peroxide film-cooling method for a 500 N scale nontoxic hypergolic thruster. The nontoxic hypergolic fuel used was Stock 3 and the main oxidizer was 95% high-test peroxide (HTP). Two different liquid film coolants, water and 95% HTP, were tested to qualitatively analyze the effects of the thermal decomposition of hydrogen peroxide on film-cooling performance. The results of the film-cooling performance tests were examined from three different perspectives: propulsive performance analysis, film-cooling performance analysis, and gaseous film-cooling analysis. The thermal decomposition process of the hydrogen peroxide film coolant contributed to alleviating the loss in propulsive performance, but degraded the film-cooling performance. Two simple analytical approaches, the inverse problem method and gaseous film-cooling method, were utilized to predict the interior surface temperatures of the chamber. The Stineman interpolation method was also useful in estimating the temperature profiles of the chamber even without temperature data from the area downstream of the nozzle throat.

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