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INVESTIGATION ON DISTRIBUTION OF MASS FLUX AND MIXTURE RATIO OF IMPINGING OF TWO CONTROLLED LIQUID SHEETS

Abstract

The performance and reliability of bipropellant rocket engine depend on the high-efficiency steady combustion and effective cooling, all of which are highly interrelated with the distribution of mass flux and mixture ratio of propellants in the chamber. In this paper, the research on impinging mixture characteristic of two controlled liquid sheets is conducted by numerical simulation and experimental verification, and the effect of expanding angle γ on the distribution of mass flux and mixture ratio and mixing efficiency(Em) is analyzed. Based on the research findings of two cylindrical jets impinging mixture characteristic and controlled liquid sheets atomization characteristic, the physical and mathematical models of the distribution of mass flux and mixture ratio generated by two liquid sheets impinging are founded. Since Em maybe has fault on evaluating the mixture of liquid rocket engine, the author defines a new concept named mixture cross rate η , which could help to evaluate the mixture characteristic of bipropellant liquid rocket engine. The validation of the model is testified by both experimental and numerical results, and the effect of parameter γ on the coefficient value in mathematical model is obtained. Based on the mathematical model, the Em of each test case is calculated. Comparing to experimental value, the relative deviation is between -0.86% and 14.9%. The effect of parameter γ on the Em is analyzed and the conclusion is made that Em increases with γ when γ is less than 60deg, but Em decreases with γ more or less when γ is larger than 60deg. Lastly, by calculating the value of η of each test case, we find that all of the values of η are larger than 1.0. The results show that cross-mixture phenomenon occurs in each experiment more or less. Keywords: controlled liquid sheet, distribution of mass flux and mixture ratio, numerical simulation, experimental investigation, mixture cross rate