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EXPERIMENTAL INVESTIGATION ON DISTRIBUTION CHARACTERISTICS OF MASS FLUX AND MIXTURE RATIO FOR UNLIKE IMPINGING INJECTOR

Abstract

In the liquid rocket propulsion system, the impinging injector geometry is a very frequently used form of the atomization and mixing of liquid propellants. For hypergolic propellants, such as Hydrazine/NTO and MMH/NTO, it's a very attractive option for propellant combinations due to the potential low cost of component fabrication and high efficiency of atomization, which is of particular interest when studying combustion instabilities. Combustion instability is always a hot topic because it can result in such penalties as low propellant efficiency or even system failure. Propellant atomization appears to be the primary source of combustion instabilities. Unfortunately, the scientific community has yet to create an effective, realistic mechanism of propellant atomization because of the complexity of the underlying physics. Currently, the issue about mixing process of the impinging jets experimentally is extremely rare, so it's necessary to research variation discipline and affecting factors of mass flux and mixing ratio to hunt for combustion instability and contribute to design of impinging injector. By the non-embedded PLIF optical technique, this study focused on flow experiment of the impinging injector using water and rhodamine solution imitating propellants to obtain time-domain and time-average characteristics of mass flux and mixture ratio. With temporal variation of 10Hz frequency, it's found that distribution of mixing ratio at downstream from the impinging point is uneven and mutative extremely. It would cause energy distribution under combustion condition cluster, especially vary as time and space which is considered a relational immensely reason impacting combustion instability. By analyzing factors affecting mixture efficiency, it's concluded that increasing of jet velocity and impinging angle is profitable on atomization and mixing under the same orifice diameter and momentum ratio and mixture efficiency is proportional to the orifice diameter ratio under different momentum ratio.