SOLID H2/D2 PARTICLE SEEDING AND INJECTION SYSTEM FOR PARTICLE IMAGE VELOCIMETRY (PIV) MEASUREMENT OF HE II

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Introduction

The Particle Image Velocimetry (PIV) technique is a unique flow characterization tool because it captures the whole flow velocity field instead of just the velocity at one single point. This technique has been widely implemented in classical fluid mechanics and aerodynamics since the 1980s; however, it has not been used for He II flow visualization until relatively recently [1]. The selection of tracer particle and seeding methods are one of the main technical hurdles to performing PIV measurements in He II flow. A solid mixture of hydrogen and deuterium has been considered to be the most promising candidate material for making tracer particles for He II flow, because it can be made close to the density to He II. The present report describes a prototype H2/D2 seeding device developed and tested for He II PIV research.

Experimental

Figure 1 shows the schematic of the experiment system. A gas sample cylinder is used as the mixing and storage space for the seeding gas. The seeding gas is first pre-cooled by a liquid nitrogen trap and then injected directly into the He II. The injector is made of a miniature solenoid valve operated by the control unit at room temperature. PIV software from Integrated Design Tools, Inc. synchronizes the Nd:YAG lasers and the CCD camera to achieve image acquisition.

Results and Discussion

Experimental results show that a decrease in the valve opening time τ, reduces the particle size. The particle image density also decreases with a reduction of the back pressure after the back pressure is below the critical value. Figure 2 shows the injection results with the optimum parameters of this experimental setup.

Conclusions

The injection system described in this paper successfully generates solid H2/D2, H2, and D2 particles. The seeding quality is repeatable under fixed control parameters. Particles generated with optimum parameters meet the PIV requirements. After further testing on the effect of orifice size, this injection and seeding system will be used to supply the tracer particles for PIV measurement of a two phase helium force flow experiment.

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References