

Control of liquid flows generated by plasma–liquid interactions

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Understanding the interactions at the interface between plasma and liquid is essential for developing plasma technology involving liquids, such as plasma medicine, plasma agriculture, water treatment, and material synthesis. Plasma-induced liquid flows have recently attracted attention as one of the important phenomena caused by physical and chemical interactions at plasma–liquid interface [1-5]. Therefore, elucidating the mechanism of plasma-induced liquid flows is crucial to explain their interactions. This study reports the relationship between plasma-generation conditions and plasma-induced liquid flows.

Fig. 1 shows a schematic diagram of experimental setup and typical plasma jets. The plasma-jet generator used in this study consists of a glass tube, high voltage electrode, and grounded electrode. Ar or He gas was supplied to the quartz tube at a flow rate of 3 L/min. plasma jet was generated by a sinusoidal 14 kV_{p-p} high voltage in the 1–12 kHz range. Plasma-induced liquid flows were analyzed by a PIV method.

Fig.2 shows typical PIV images at frequencies of (a) 4 kHz, (b) 5 kHz, (c) 6 kHz, and (d) 10 kHz for Ar gas. A downward flow that linearly moved in the $-y$ direction was observed for 4 kHz, whereas a upward flow was generated for 10 kHz. Fig.3 reveals how the flow changes continuously with frequency. The results show that flow direction drastically changed at the frequencies between 4 and 7 kHz. A similar trend did not occur for He gas. Detailed results will be reported including liquid-flow control in the presentation.

References

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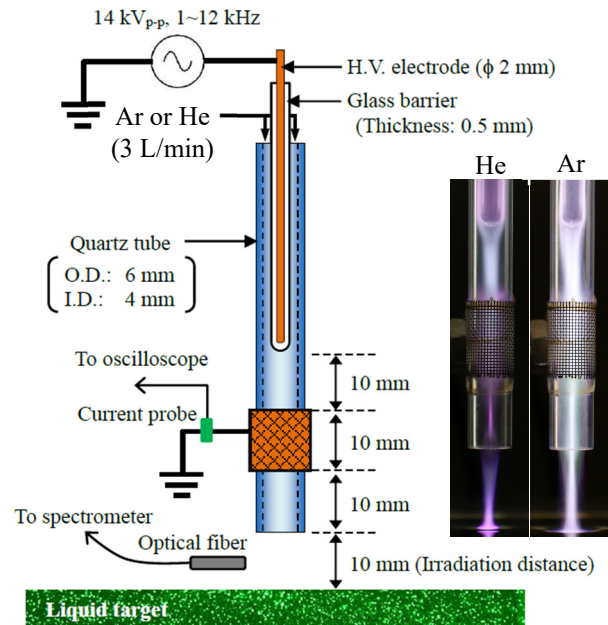


Fig. 1. Schematic diagram of experimental setup and typical plasma jet.

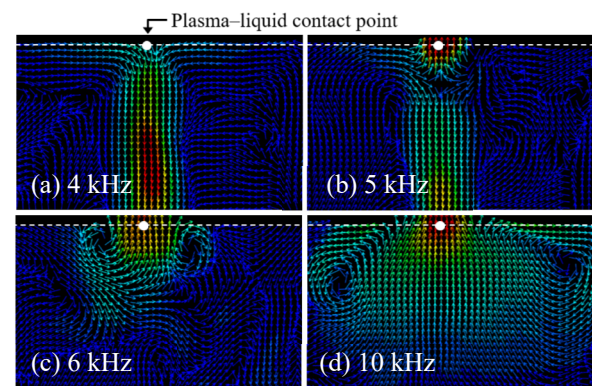


Fig. 2. Typical PIV images for Ar gas.

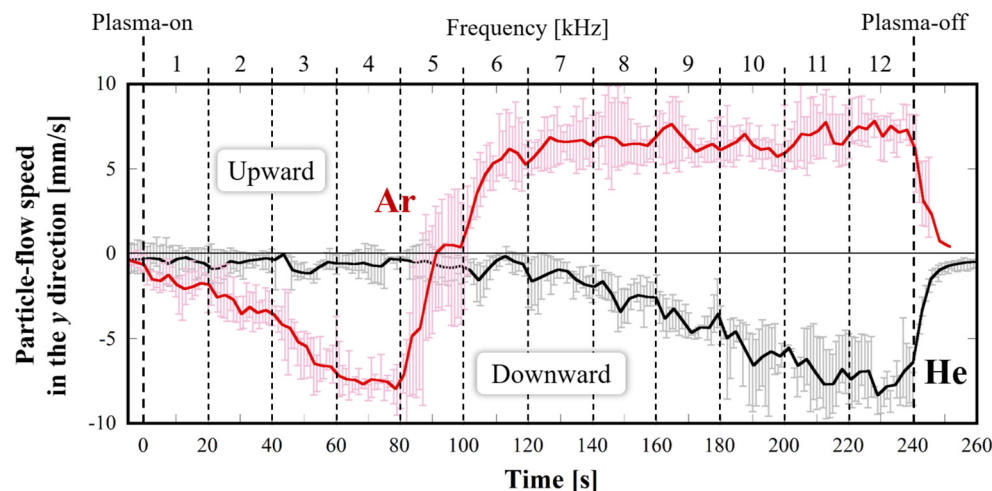


Fig. 3 Effects of supplied gas on plasma-induced liquid flows. Frequency was varied from 1 kHz to 12 kHz with time at a constant applied voltage of 14 kV_{p-p}.