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(G*) (POS-14) Optical and X-ray imaging of a millimeter-scale spark discharge initiated at the water-heptane interface.

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Discharges in liquid is a growing field of study in the cold plasma community. The non-equilibrium properties of such plasmas enable the production of reactive species in the liquid phase, which trigger some chemical reactions not accessible using the conventional chemical processes. Such unique properties make in-liquid discharges promising for different applications, namely liquid depollution, dye degradation, or nanoparticle synthesis. The ignition of a discharge in liquid is not straightforward due to high liquid density, and pulsed high voltages with fast rising period are usually required. For instance, in deionized water with a pin-to-plate electrode configuration separated by a gap of ˜300 µm, a voltage of ˜20 kV is needed to ignite a discharge. The characterization of such a small discharge, e.g. by imaging, is challenging. Further, the strong discharge emission hinders fundamental understanding of the discharge development. More recently, we have demonstrated that discharge ignition can be facilitated in water by adding a layer of low dielectric liquid at the top of water. This is due to the difference of the dielectric permittivity of the two liquids, which enhances the electric field magnitude, and thus, allows the ignition of a discharge that has a length of several mm (up to 4 mm at 20 kV amplitude and pulse width of 500 ns). In this study, we present the characteristics of such discharges using different imaging techniques. First, we used 1 ns time-resolve ICCD imaging of the discharge emission in the visible range. Second, a backlight imaging using a high-speed camera to study the bubble dynamics after the discharge at µs time scale. Finally, betatron x-rays from a laser-plasma accelerator were used to image the first instants of the discharge. This novel imaging technique reveals the dynamics of a low-density region induced by the discharge, which is typically obscured by saturation in the visible range.

Keyword-1

plasma-liquid

Keyword-2

plasma-interface

Keyword-3

X-ray imaging

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