

Ignition of nanosecond discharges in liquids: optical analysis at different voltage polarities

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Nanosecond plasmas in liquids are used for a variety of applications, such as water treatment, electrolysis, or biomedical applications. The exact nature of these very dynamic plasmas and their ignition physics are strongly debated. We analysed nanosecond plasmas in water that are created by ± 20 kV voltage pulses applied to a sharp tungsten electrode. Fast camera measurements and emission spectroscopy show that plasma ignition is dominated by field effects at the electrode-liquid interface. Emission spectra analysis shows hot electrode surfaces at 7000 K and 4500 K for positive and negative polarity, respectively. Plasma propagation is governed by field effects in a low-density region that is created either by nanovoids or by density fluctuations in supercritical water surrounding the electrode that is created by the high pressure and temperature at the moment of plasma ignition.