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Microsecond electrical breakdown in water: advances using emission analysis and cavitation bubble theory

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Electrical discharges in water are a subject of major interest because of both the wide range of potential applications and the complexity of the processes. This topic aimed to provide significant insights to better understand processes involved during a microsecond electrical discharge in water, especially during the propagation and the breakdown phases. Two different approaches were considered. The first analysis focused on the emission produced by the discharge during the propagation using fast imaging measurements and spatially resolved optical emission spectroscopy. The excited species H, O, and OH were monitored in the whole interelectrode gap. The second analysis concerned the thermodynamic conditions induced by the breakdown of the discharge. The time evolution of the bubble radius was simulated and estimation of the initial pressure of the cavitation bubble was performed using the Rayleigh–Plesset model. Values of about 1.7×10^7 Pa and 1.2×10^8 Pa were reported for the cathode and anode regimes, respectively. This multidisciplinary approach constitutes a new step to obtain an accurate physical and chemical description of pin-to-pin electrical discharges in water.

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