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(G*) Production of emulsion by discharges at the interface of two immiscible liquids

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Pulsed spark discharges in dielectric liquids have various applications such as precise machining, nanomaterial synthesis, or for liquid depollution/reformation. Discharge in liquids produce highly reactive species, in addition to shock waves, heat, and radiation. Discharges at the interface of two immiscible liquids have been recently introduced, and they showed great interests for fundamental as well as for applied studies. For instance, due to E-field enhancement at the interface, it was possible to sustain discharges with 100% of probability of occurrence. These discharges simultaneously dissociate the two liquids, which opens the way to a novel plasma concept.
In this work, spark discharges are produced between two-copper electrodes, mounted parallel to the interface of two liquids: distilled water and heptane. The discharges were produced using pulsed high voltage with amplitude of 20 kV and pulse width of 500 ns, at low repetition rate (5 or 50 Hz). The waveforms of the voltage and the current of each discharge were acquired, and then automatically processed, using algorithm, to determine some characteristics. For instance, we determined the temporal evolution of the probability of discharge occurrence as a function of electrode-interface distance. The results have shown that the highest probability is obtained when the electrodes are at the interface. This is because the electric field is intensified by the interface. Moreover, the liquids changed color and became milky. Such change is due to the production of emulsion, i.e. droplets of heptane in water. The size distribution of the emulsion has been determined using dynamic light scattering (DLS). The production of the emulsion is due to the generation of cavitation bubbles that oscillate (series of explosion-implosion motion) at the interface. DLS measurements showed that the spark-generated emulsion has a size distribution range between few tens of nanometer to few micrometers.

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