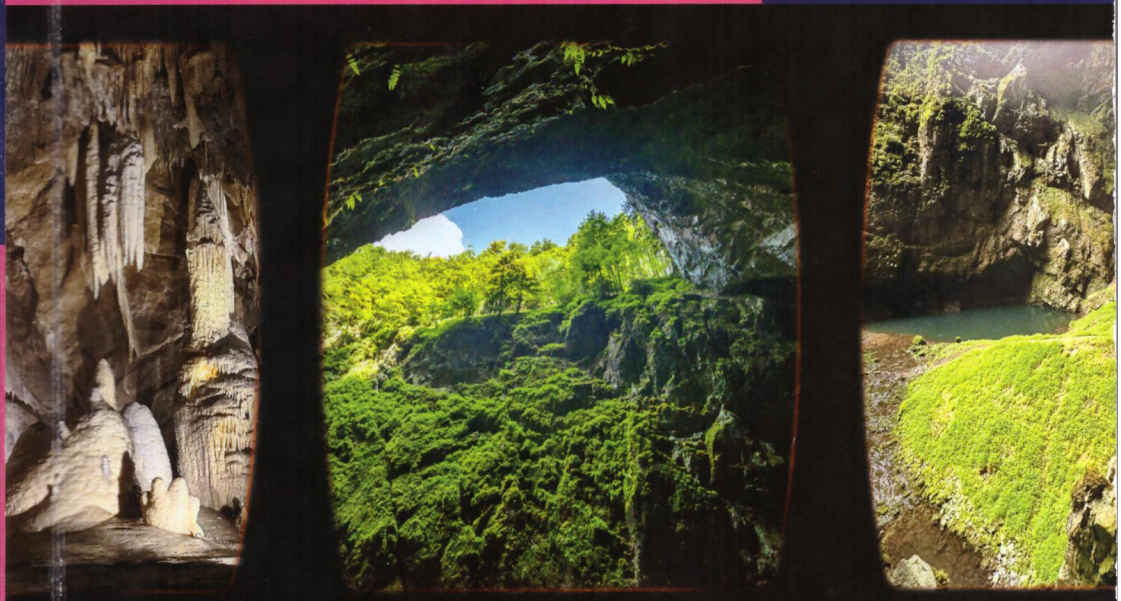
The 4th Plasma Nanotechnologies and Bioapplications Workshop

SCIENTIFIC PROGRAM & BOOK OF ABSTRACTS



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Generation of plasma activated water with biocidal effects by transient spark combined with electrospray

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Abstract

Plasma-activated water (PAW) contains a mixture of reactive oxygen and nitrogen species (RONS) and has a wide range of applications in the health, agriculture, and food sectors [1]. Given that some applications require a specific chemical composition, we studied the generation of PAW using a transient spark (TS) discharge in various gases (N_2, O_2, and synthetic air, both dry and humidified). This was achieved through either direct or indirect contact of the discharge with water microdroplets formed by an electrospray (ES) process [2].

We also investigated how to enhance nitrogen fixation in water. This was accomplished by converting the weakly soluble nitrogen oxides (NO and NO_2) — generated by the TS discharge — into highly soluble dinitrogen pentoxide (N_2O_5) and nitric acid (HNO_3) in the gas phase.

To better understand the interaction between the transient spark and microdroplets, we used an ultrafast camera (Fig. 1) and a Schlieren imaging method (Fig. 2) for visualization of the transient spark with and without a water inlet to the reactor. Our observations revealed that the presence of a transient spark significantly distorts the electrospray process due to both electrical forces and turbulent gas mixing. Taylor cone is not formed, electrospray microdroplets are released from irregular water structures. Moreover, microdroplets are also created by two different mechanisms: ablation from the point where the spark channel touches the water surface or the Coulomb explosion of relatively large water volumes.

Figure 1: An illustrative image of the transient spark's interaction with water, captured by an ultrafast camera.

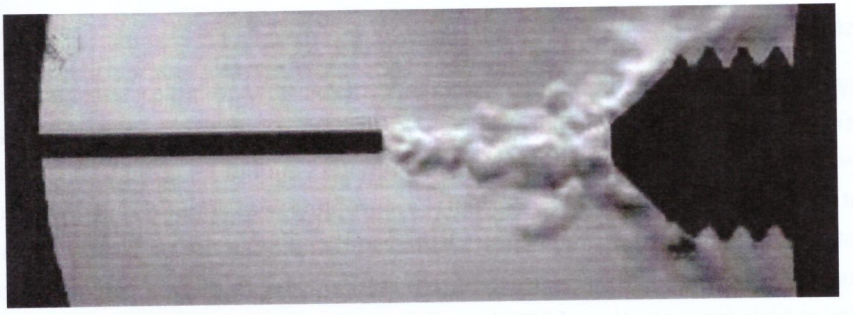

Figure 2: An illustrative image from Schlieren imaging of transient spark discharge.

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Keywords:

transient spark, electrospray, plasma activated water, ultrafast camera visualization, Schlieren imaging

References

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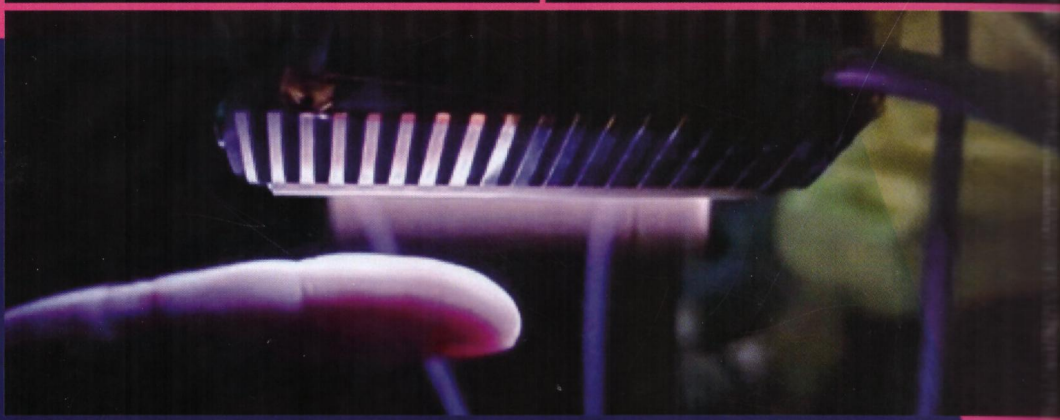

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