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Cold atmospheric plasmas applied to biology – From physics to biology, via chemistry

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Abstract

In the last decade, Cold Atmospheric Plasmas (CAPs) have attracted the interest of the international scientific community for their multitude of potential applications in sterilization, medical, and agricultural fields [1,2,3]. The main feature of CAPs is the presence of an energetic population of electrons, along with ions and gas molecules at ambient temperature. This gives access to a rich chemistry of reactive species while maintaining local temperature low and thus applicable to biological substrates. Furthermore, CAPs constitute an environmentally friendly alternative to chemicals, besides being simple, cost-effective, and industrially scalable [4].
In the first part of this seminar, a brief introduction to CAPs and their previously listed advantages will be provided. The CAP source that is mostly used at the Bioplasma laboratory of the Swiss Plasma Center (SPC) will be presented: a Surface Dielectric Barrier Discharge (SDBD). The main research topics addressed in our laboratory will then be discussed, joining plasma physics, chemistry, and biology: 1) Direct treatments of bacteria (*Escherichia coli*), including the associated spatial and temporal characterization of reactive species produced near the plasma through Fourier Transform Infrared Spectroscopy (FTIR) and Laser-Induced Fluorescence (LIF) [5]; 2) Indirect treatments of *E. coli* through Plasma Activated Water (PAW), with microfluidic fluorescence experiments [6]; 3) Single-Cell Impedance Flow Cytometry (IFC), to extract information on the dielectric properties of bacteria after plasma treatment; 4) Decontamination of liquid wastes featuring pathogenic microorganisms, as a partial alternative to autoclaves; 5) *Microdochium nivale* sterilization on wheat seeds.

References

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