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Cold atmospheric plasma processes for water activation: investigating chemical selectivity and energy efficiency for agriculture and medicine applications

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The aim of our research works is to bridge plasma technology with Life Sciences applications to offer innovative plasma solutions where conventional processes fail or are limited. In that framework, the activation of water stands for a major issue first in agriculture and second in medicine.
We have developed several plasma processes based on a DBD approach, including (i) matrix configurations enabling the treatment of large volumes of water and (ii) bubbling systems where calibrated bubbles of post-discharge gases interact with the liquid to enhance its concentration in radicals species.
A complete experimental set of analytical techniques dedicated to the characterization of long lifetime chemical species has been implemented using colorimetry and acid titrations techniques considering acid-base equilibria, pH and temperature variations induced during plasma activation. 16 species are quantified and monitored, including ammonia, orthophosphates, carbonate ions, nitrite/nitrate ions, hydrogen peroxide, etc. The related consumption/production mechanisms are discussed as well as their interaction with the gaseous phase. In parallel, a chemical model of electrical conductivity based on Kohlrausch's law has been developed to simulate the electrical conductivity of the plasma-activated water. The processes are then compared in terms of chemical selectivity and energy efficiency in order to forecast their potential in seeds biology and cancerology.

Keywords
DBD in parallel
Agriculture
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RO(N)S
energy efficiency