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Promising research results on a few potential applications of non-thermal plasma

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Due to its non-equilibrium character, non-thermal plasma is able to promote a large variety of chemical reactions and to produce numerous highly reactive species, and thus shows great potential for a number of applications.

This talk will present experimental results on some of these possible applications: (i) the degradation of organic compounds in water, in view of wastewater treatment; (ii) plasma treatment of seeds for agricultural applications; (iii) material synthesis and processing.

The first part will focus on the degradation of pharmaceuticals, especially on antibiotics, a class of emerging water pollutants of high concern due to their contribution to the spread of antimicrobial resistance. Recent progress on the use of non-thermal plasma for removing these contaminants will be described. The discussion will address the ways to improve process efficiency associated with the discharge configuration and the main experimental parameters, as well as fundamental findings related to degradation pathways and mechanisms of various classes of antibiotics under plasma conditions.

Plasma agriculture is a novel and rapidly developing research field, aimed at enhancing plant vigor and improving yield while reducing the environmental footprint of conventional agricultural methods. The talk will address pre-sowing seed treatment by non-thermal plasma, which was generally found to improve germination, enhance plant growth, as well as to decontaminate seeds and to enhance stress tolerance and plants resistance to diseases. A few examples will illustrate these findings, both under laboratory conditions and in field trials.

The last section of the talk will be dedicated to the effects induced by the exposure of graphene materials to non-thermal plasma, as a part of the large interest in developing metal-free catalysts. It was found that plasma treatment produces various types of defects, which act as catalytic centers, and thus considerably improve the catalytic activity. Finally, the use of non-thermal plasma for the stabilizer-free synthesis of nanoparticles will be briefly addressed.

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