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Investigation of Nanosecond Pulsed Cold Atmospheric Plasma (NSP-CAP) as a Means to the Highly Energy Efficient Degradation of PFAS in water

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Poly- and perfluoroalkyl substances (PFAS) are a class of organofluorine compounds liberally used over the past 60 years in aqueous film forming foam (AFFF), household products, etc. Perfluorooctanoic acid (PFOA) is widely used, while PFOA water contamination is intense often surpassing the EPA's lifetime health advisory (the limit is 70 ng/L). Due to extensive PFAS contamination in drinking water and their associated health risks, there has been a great focus on developing practical and effective water treatment technologies. Treatment technologies developed so far include adsorptive and destructive methods. Adsorptive methods to date exhibit promising results on the effective removal of some of PFAS but can be expensive and can cause secondary pollution due to the generation of PFAS contaminated residues. On the other hand, due to the recalcitrant nature of PFAS and the C–F bond, destructive methods face important challenges.[1] A promising destructive treatment technology which is well-established for its efficiency to remove a wide range of persistent contaminants in water is Cold Atmospheric Plasma (CAP) exhibiting advantages such as high energy efficiency, effectiveness, rapidness, and green character.[2] In this study, a novel highly energy efficient CAP method is implemented for the degradation of PFOA in water. A nanosecond pulsed (NSP) generator with a rising time of 4 ns and an in-liquid configuration of the CAP reactor for the direct generation of plasma species in the form of bubbles inside water, were used in order to maximize the energy efficiency of the process. The impact of the most critical parameters including treatment time, pulse voltage/frequency, plasma gas, PFOA initial concentration, etc. have been examined in detail for the method optimization.

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