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Transient Plasma-based Remediation of Nanoscale Particulate Matter

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Recent studies have shown ultrafine particulate matter (UFPM) produced by a variety of sources represents a serious health hazard and has been associated with various forms of cancer. In this study, we demonstrate a highly effective method for treating restaurant smoke emissions using a transient pulsed plasma reactor based on a nanosecond high voltage pulse generator and also explore the remediation effect of transient pulsed plasma together with an applied DC-bias. We measure the size and relative mass distribution of particulate matter produced in synthetic and actual commercial charbroiling processes (e.g., cooking of hamburger meat) both with and without the plasma treatment. With plasma treatment, we observe up to a 55-fold reduction in total particle mass and a significant reduction in the nanoparticle size distribution using this method for charbroiler emission. For synthetic emission with both polyaromatic olefin PAO-4 and soybean oil, we found that a more than three-order-of-magnitude reduction in particulates can be achieved by this plasma discharge with applied DC bias. The effectiveness of the UFPM remediation increases with both the pulse repetition rate and pulse voltage, demonstrating the scalability of this approach for treating higher flow rates and larger systems.

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