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Fast-Modulated Surface-Confined Plasma for Catalytic Nitrogen Fixation and Energy Intensification

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Abstract : Nitrogen fixation is critical for plants for the biosynthesis of protein and nucleic acid. Most of our atmosphere is nitrogen, yet plants cannot directly absorb it from the air, and natural nitrogen fixation is insufficient to meet the demands. This experiment used a fast-modulated surface-confined atmospheric pressure plasma created by a 6 kV (peak-peak) sinusoidal power source with a repetition frequency of 68 kHz to fix nitrogen. Plasmas have been proposed for excitation of nitrogen gas, which quickly oxidised to NOX. With different N2/O2 input ratios, the rate of NOX generation was investigated. The rate of NOX production was shown to be optimal for mixtures of 60–70% O2 with N2. To boost NOX production in plasma, metal oxide catalysts based on TiO2 were coated over the dielectric layer of a reactor. These results demonstrate that nitrogen activation was more advantageous in surface-confined plasma sources because micro-discharges formed on the sharp edges of the electrodes, which is a primary function attributed to NOX synthesis and is further enhanced by metal oxide catalysts. The energy-efficient and sustainable NOX synthesis described in this study will offer a fresh perspective for ongoing research on green nitrogen fixation techniques.

Keywords : nitrogen fixation, fast-modulated, surface-confined, sustainable
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