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Plasma Bubbles: A route to Green Chemistry

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The interface between plasma and liquid plays an important role in the mass transfer and formation of reactive oxygen and nitrogen species in liquids. The plasma bubbles provide a large interaction surface area and also reduce the breakdown voltage and energy consumption for water activation. Our goal is to replace chemicals or energy from the burning of carbon-based fuels with supplies of "green" electrons. This presentation will fully describe the plasma bubble technology from the aspects of plasma characteristics, gas-liquid mass transfer and green chemistry applications, including water purification, H_2O_2 synthesis and sustainable nitrogen fixation. This presentation mainly includes: (1) Regulation of the number and size distribution of plasma bubbles by controlling the number and size of microholes drilled on the reactor tube. To study the discharge properties of the plasma microbubbles and to quantify the mass transfer process of the plasma active substance from the gas phase to the liquid phase, the reactor is used for the efficient degradation of antibiotic wastewater; 2) Using a solar-driven plasma bubble reactor to regulate the discharge mode of the plasma by designing the electrode structure, further addition of photocatalyst 2D-TiO_2/g-C_3N_4 with a two-dimensional nanosheet structure can be employed to enhance the plasma catalysis for small-scale, green, and efficient catalyzed synthesis of H_2O_2; 3) Using air and water as raw materials, regulation of activated air molecules using plasma bubble reactors with different discharge modes can enable the control of the liquid-phase NOx generation, which can be further combined with the electrochemical reduction device for the highly efficient synthesis of ammonia. Therefore, further optimization design of plasma microbubble reactors is expected to improve the gas activation and selective regulation of reactive species in aqueous solutions, and to provide technical guidance for their related applications.

References

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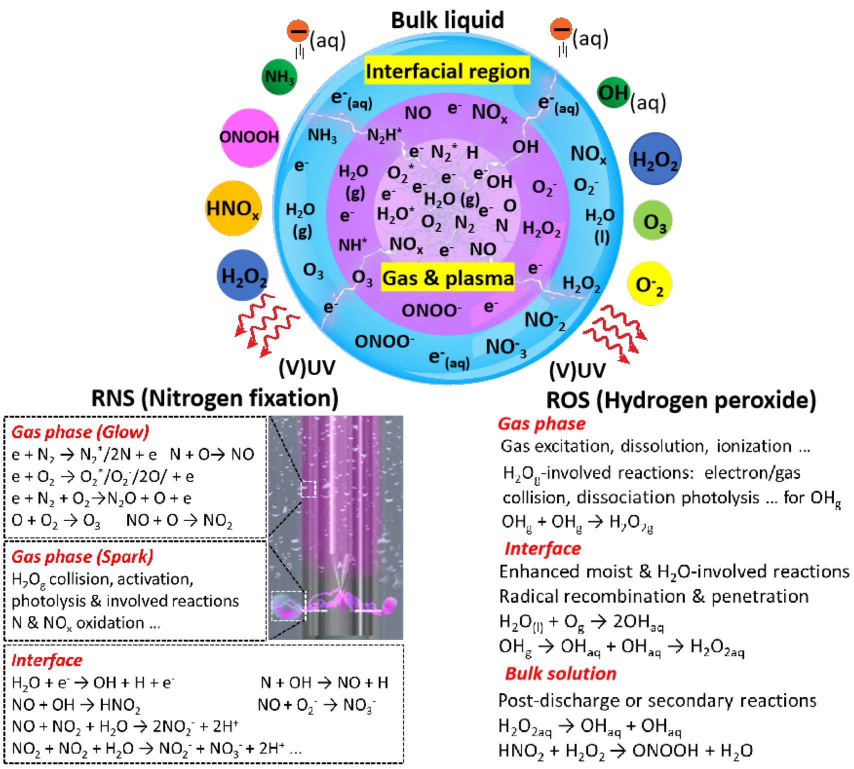

Figure 1 Reactive species generated and typical reactions involved at different stages for H_2O_2 formation and nitrogen fixation.