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Characterization of Atmospheric Pressure Dielectric Barrier Discharges for Environmental Applications

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Two types of atmospheric pressure glow discharge (APGD) schemes, i.e., a conventional parallel-plate type and a microplasma-integrated type, are compared from viewpoints of those plasma parameters and other physicochemical characteristics. In the former type, the discharge tends to constrict showing filamentary appearance as the current density increases. The tendency becomes noticeable when electronegative gases such as O_2 and H_2O are included. Therefore, in the glow mode the electron density cannot exceed the order of 10^{11} cm^3, as measured by a mm-wave transmission technique, even though an elaborate method to control the voltage waveform is performed. The mechanisms concerning with the filamentation will be argued based on the variation of the accumulated charge density on the dielectrics from the spatially resolved measurement by a Pockels-effect method. On the centrally, the latter type with such a structure composed of stacked metal-mesh covered with dielectrics has been proved to be promising for stable operation at higher plasma density in the order of 10^{12} to 10^{13} cm^{-3} even with admixtures of O_2 and H_2O. This is of much advantage for many environmental uses in the effective production of oxidizing precursors such as O, OH and O_3. In order to effuse the plasma out of the mesh-electrode holes, the effect of gas flow has been studied, and the modified structure enabling higher flow velocity is going to be tested together with the optimization of the operating frequency and the voltage waveform. The results of laser spectroscopic diagnostics of those radicals and ions such as N_2^+ will be explained at the conference.