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Particle-in-cell and Monte Carlo collision simulation of dielectric barrier discharges

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Plasma catalysis, which combines the high activity of plasma and the selectivity of catalytic materials, has been successfully applied in material processing and chemical substance synthesis. This talk presents some numerical simulation results on packed bed and surface DBD by using 2D particle-in-cell/Monte Carlo Collision (PIC/MCC) models. The effects of catalyst pores, adjustable parameters, and side electrodes are investigated.

The surface discharge in catalyst pores, the propagation direction of the streamers, and the composition of products are essential factors that could affect plasma catalysis's energy efficiency and catalytic efficiency. The results showed that various parameters, including the size of catalyst pores, applied voltage, dielectric constant, discharge interval, gas mixing ratio, and side electrode voltage, had essential impacts on these factors. The results also show that the presence of the catalyst pores could enhance the steamer intensity and control the direction of the streamers, yielding highly concentrated reactive species inside catalyst pores.

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