Dissociation of carbon dioxide using a microhollow cathode discharge plasma reactor at atmospheric pressure

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In recent years, there is increasing interest in CO_2 dissociation using low-temperature plasma techniques. Micro-hollow cathode discharge (MHCD) can be sustained at high pressure with low input power, which also features high power density,providing a highly reactive environment for chemistries. In this study, Micro-hollow cathode discharge (MHCD) used as a micro-reactor for dissociating CO_2 at atmospheric pressure has been experimentally investigated. The main structure of MHCD consists of two copper electrodes covered by a mica dielectric layer on both sides, through which a cylindrical hole is drilled. In the experiments, pure CO_2 was fed through the MHCD hole, and the self-pulsing regime was observed in most of the situations through voltage and current measurements. Experiments within different operating parameters such as applied voltage and flow rate were conducted. It was found that the maximum of conversion yield exceeds 10% and a maximum of energy conversion efficiency is close to 10% for the MHCD dissociation of CO_2. It was also found that the self-pulsing regime plays a vital role in CO_2 dissociation compared to the normal glow discharge mode. Based on the experimental results, a preferable hole diameter was chosen to operate arrays of MHCDs which can enlarge the plasma volume. Appropriate combination of the key operational parameters allows for good performance of the MHCDs functioning as a CO_2 dissociation reactor. The results of this study provide further insights to operating MHCD for efficient gasdissociation at atmospheric pressure.

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