Investigation of carbon dioxide decomposition in a micro-slit discharge at low pressures

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The breakdown voltage and current–voltage characteristic are essential parameters for understanding microplasma discharges and for optimal design of microplasma reactors. A metal–dielectric–metal sandwich configuration, consisting of two molybdenum foils with slit openings of different lengths at the anode, separated by mica layers of different thicknesses *d*, was used in this study. The measurements were performed in carbon dioxide under pressures from 4 to 40 Torr. It was found that although the breakdown curves in carbon dioxide generally follow the conventional Paschen's law, significant deviations occurred for the different cases in this study. The deviations may be due to the non-uniformity of electric field and the loss of charge carriers by diffusion to the inner wall of the slit. Current–voltage characteristics of the micro-slit discharge for different slit lengths and different pressures are presented. For a single-slit discharge, current–voltage curves are characterized by a positive slope, and the slopes decrease with increasing slit length and operating pressure. For the micro-slit array discharge, the sawtooth shape of the increasing current branch of the current–voltage curve is shown to be due to the change in the number of individual discharges and redistribution of current in the ignited opening slits.The formation of a stable discharge for the micro-slit array without individual ballasting allows the construction of large area, thin plasma sources for dissociation of carbon dioxide.

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