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Discharge mode transition in a high-pressure RF capacitive discharge S.Y. MOON, D.B. KIM, J.K. RHEE, W. CHOE, Department of Physics, Korea Advanced Institute of Science and Technology, 373-1 Guseong-dong, Yuseong-gu, Daejeon 305-701, Korea — α and γ mode of a RF helium capacitive discharge were investigated at higher than 5 torr up to atmospheric pressure. The discharge source consisted of two parallel electrodes of same diameters of 60 mm for avoid the self-bias voltage. The discharge gap was fixed as 1 cm at (5 – 200) torr and varied from 0.5 mm to 5 mm at atmospheric pressure. α and γ modes and the mode transition were observed with a nearly 40% voltage drop and a 55% V-I phase angle decrease. The relation between the mode transition voltage and the multiplication of pressure and distance (pd) looked similar to the Paschen curve. At atmospheric pressure, the mode transition occurred abruptly with an instantaneous arc generation, different from a smooth transition at lower pressures. At less than 3 mm gap, an abnormal glow discharge occurred, showing a linear current increase with respect to the voltage. At 3 mm gap, α mode excited as a normal glow discharge with a constant current density (17 mA/cm^2). At over 5 mm gap, either γ mode was excited or the discharge was extinguished. It means there is a critical $(pd)_{cr}$ value for α-mode generation at atmospheric pressure, like at lower pressures. From the experimental result and a simple electrical circuit model, we conclude that the transition between two modes resulted from the α-sheath breakdown.

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