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A NON-EQUAL GAP DISTANCE DIELECTRIC BARRIER DISCHARGE: BETWEEN SPIRAL-SHAPE AND CYLINDER-SHAPE ELECTRODES*

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A non-equal gap distance DBD between a spiral-shape electrode and a cylinder-shape electrode is reported. A spiral-shape air plasma is generated when a nanosecond pulse voltage is applied to the two electrodes. The smaller the pitch of the spiral-shape electrode is, the more diffuse of the air plasma appears. The discharge current has a pulse width of more than 400 ns, which is much longer than that of ordinary DBDs in air. According to the high speed photographs of the plasma captured by an ICCD camera, the discharge first ignites at the position where the gap distance is smallest, then it propagates continuously along the spiral electrode with the increase of gap distance at a speed of about 10^6 m/s, which is at least one order faster than the propagation speed of plasma bullet in noble gas. Both optical emission spectrum method and electric field induced second harmonic (E-FISH) method are employed for measurement of the electric field at different locations. The obtained electric field from both methods have good agreement and are in the range of 60-105 kV/cm depending on the gap distance of the locations, which is much higher than the breakdown voltage of air under direct current (DC) voltage.

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