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AN ATMOSPHERIC PRESSURE GLOW DISCHARGE IN AIR STABILIZED BY A MAGNETIC FIELD AND ITS APPLICATION ON NITROGEN FIXATION*

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An atmospheric pressure glow discharge in air stabilized by a magnetic field is reported. The plasma is fixed at a position when the direction of the Lorentz force and the direction of the air flow is opposite. The effects of the applied voltage, the magnetic field and the air flow rate on the plasma characteristics, including the electrical characteristics, the dynamics of the discharge, the electron density, the reduced electric field, and the rotational and vibrational temperature of the plasma, are studied. For applied voltage of 6.5kV, air flow rate of 2L $\cdot$min^{-1}, and magnetic field of 0.11T, the discharge is under direct current (DC) discharge mode with discharge voltage (V_{dis}) and discharge current (I_{dis}) of 1.2kV and 49.7mA, respectively. The rotational and vibrational temperature is about 3420K and 4550K respectively. The electron density is on the order of 10^{14}cm^{-3} and the reduced electric field of plasma is about 36.9 Td, which is favorable for vibrational excitation of N_2 to promote the production of NO_x. Because the plasma is fixed at a position, all the gas has to pass the plasma region and treated by the plasma when they are flowing, which is not the case for traditional gliding arc discharge where only a little percentage of gas is actually treated by the plasma. The energy cost of NO_x production for the plasma stabilized by magnetic field of 0.19T is about 2.65MJ $\cdot$mol^{-1}, which is 41% lower than the traditional gliding arc (GA) discharge. Besides, if the direction of the magnetic field is reversed, although the plasma appears in much larger region, the energy cost of NO_x production is much higher than the case of traditional GA discharge.

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