Characterization of Voltage and Gap Effect On Plasma Temperature And Electron Density In Argon Pin-to-plate DBD Plasma By Optical Diagnostics

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Gas temperature and electron density are important parameters for plasma applications specially surface treatment and surface coating, so that different techniques have been used to evaluate these parameters among which optical emission spectroscopy (OES) has several advantages. In this study, the temperature and the density of dielectric barrier discharge (DBD) plasma is diagnosed via OES technique. The plasma is generated by a pin-to-plate configuration in atmospheric pressure. The temperature is evaluated using Specair software through $\Delta v=\text{1}$vibrational transition of N22nd positive system spectrum. Rotational temperature is supposed to be the gas temperature due to fast rotational relaxation in atmospheric pressure plasmas. Furthermore, vibrational temperature is generally close to electron temperature (Te) because vibrational state of molecular species is controlled by electron impacts. Electron density is another parameter derived from Stark broadening of H\textsubscript{\alpha} including Van der Waals broadening too. Effect of gap between the electrodes and applied voltage on temperature and density of plasma are studied. Electrode gap is varied between 1.5-3 cm and the applied voltage variation is 12-16 kV. All experiments repeated four times to define standard deviation as statistical error. The results show that gas temperature increases by both voltage and electrode gap increase in Ar plasma. The gas temperature range is 800-1300 K. Furthermore, it is found that the electron temperature doesn’t change significantly by increasing voltage, but had a decreasing behavior by gap increase. Teis found to be around 2000-2200 K. The obtained electron density doesn’t change in the studied voltage range so that the investigated plasma can be considered in a saturation regime. Finally, in the considered system electron density is evaluated about $10^{16}$-$10^{17}$cm$^{-3}$in the studied range of gaps and voltages.

Keywords
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