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Production of OH and O radicals with Air/H_2O and $Air/Ar/H_2O$ atmospheric pressure gliding arc discharges plasma jet

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In the recent years, atmospheric pressure plasma jets are drawing interest for their wide area of applications including water purification [1], agriculture [2], polymer surface modification [3] and so on. Many research groups deliver attention in the production of OH and O radical at atmospheric pressure [4, 5]

In this work, atmospheric pressure Air/H_2O and $Air/Ar/H_2O$ gliding arc plasmas are produced by a $250Hz$, $4-7\ kV$ dc pulsed power supply. The schematic diagram of the experimental setup is shown in Fig. 1.

This investigation reveals that Ar plays a significant role in the production mechanism of OH and O radicals. Plasma is characterized both electrically and optically (OES). The *V-I curve* reveals that the discharge current changes due to the contribution of species produced and power dissipation ($\sim 15\ to\ 20W$). The relative intensity, rotational (T_r), gas (T_g), excitation (T_{exc}) temperatures and electron density (n_e) are studied as a function of applied voltage and air flow rate. Relative intensities of OH and O radicals indicate that the generation of OH and O radicals are increased with increasing Ar content to the gas mixture and applied voltage as shown in Fig. 2. T_r is determined from $OH(A^2\Sigma^+(v''=0) \rightarrow X^2(v'=0))$ bands with the aid of LIFBASE spectroscopic simulation software. T_g and n_e are approximated from the Voigt fit of H_β line using Doppler and Stark broadenings, respectively. We found that $n_e \approx 10^{14}\ cm^{-3}$ and $T_g \approx 560-1180K$ for different experimental conditions. n_e reveals that the higher densities of active species are produced in the discharge due to more effective electron impact dissociation of H_2O and O_2molecules caused by higher kinetic energies as gained from enhanced electric field [4]. T_x is determined employing Boltzmann Plot method using Ar^+ lines. Analyzed result provides that T_x exists in the range from $4000K$ to $7000K$.

The productions of OH and O are decreasing with increasing air flow rate but enhanced air flow rate significantly modifies discharge maintenance properties. On the other hand, Fig. 3 shows T_g significantly reduces with the enhanced air flow rate.

References

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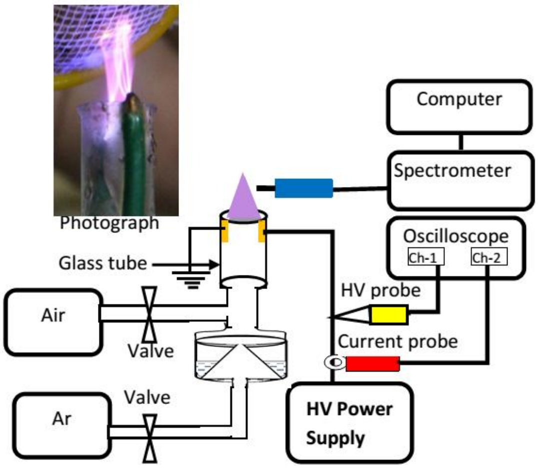

Fig. 1. Schematic of the experimental setup with discharge photograph

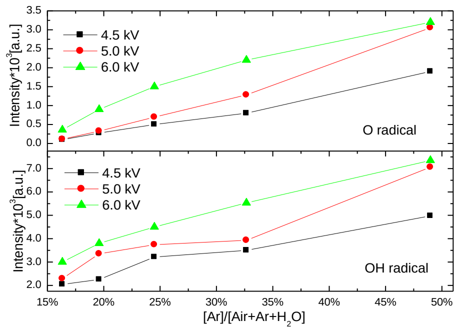

Fig.2. Relative intensity of $OH(A-X)$, and O radical as function of Ar addition at applied voltage $5kV$

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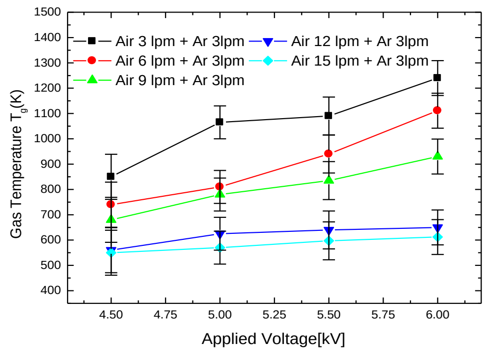

Fig.3. Effect of applied voltage on T_g as a function of applied voltage with the changing of Air flow rate.