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An Experimental Study of Atmospheric Pressure Plasma Jet

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Abstract

This paper reports the development of a non-thermal plasma jet with a capillary configuration working at atmospheric pressure. The jet is operated at an excitation frequency of several kHz with nitrogen or argon as working gas. The plasma je thus obtained has been characterized by optical emission spectroscopy and electrical measurements using voltage and current probes. The electron temperature has been estimated by using the modified Boltzmann plot method utilizing the Ar 4p-4s transition. The electron temperatures at various positions along the plasma jet length have been obtained. The results show that the electron temperature decreases at position further from orifice. The electron density has been estimated from current and voltage measurements using the power balance method. The effects of gas flow rate, applied voltage and frequency on the characteristics of the plasma jet have also been investigated.

The applications of the jet to modify the surface properties of Polyethyleneterephthalate (PET) and polycarbonate (PC) have been tested. Our results show that the plasma jet can effectively enhance the surface wettability and surface energy of the PET and PC. The plasma jet has also been tested for inactivation of prokaryotic cells (*Escherichia coli, Staphylococcus aureus*) to obtain better than 4 $\log_{10}$ reduction in the case *E. coli.* The effect of plasma jet on the pH of cell culture medium has suggested that the plasma species, particularly the electrons, are solely responsible for inactivating living cells.

References

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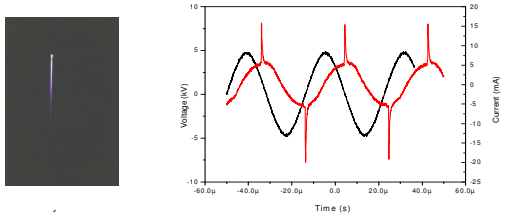
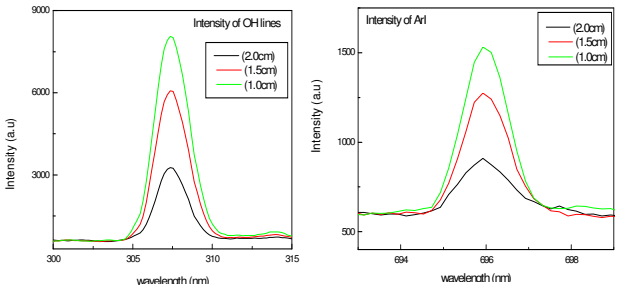


(a) (b)

Fig. 1: (a) Image of the plasma jet; (b) Electrical signals of the discharge.



(a) (b)

Fig. 2: Intensity of (a) OH and (b) Ar-I spectral lines at different position of jet along its length.