Rotational, vibrational and electronic temperatures of pulsed corona discharge at atmospheric pressure in humid air

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This work is devoted to the studies of pulsed corona discharge in point-to-plane geometry in air humid at atmospheric pressure by optical emission spectroscopy (OES). In the first time the rotational, vibrational and electronic temperatures are studies as a function of several parameters (applied voltage, frequency and rate hygrometry) near the anodic tip. In the second time we fixed applied voltage at 6.4Kv, frequency at 10kHz and rate hygrometry at 100%, then studies the spatial variation along the z axis (from the tip to the cathode plate) of electronic temperature (with a step of 2 mm for point to plane), the objective is to determine the variation of the electronic temperature in the interelectrode space along the discharge. The electronic temperature decrease versus the inter-electrode distance from the tip to the cathode plate. This result is coherent with electron energy in the case of streamer corona discharges in the region close the high voltage tip.

1. Determination of rotational and vibrational temperatures

A free code of LIFbase was used to generate the synthetic spectrum of first negative system N^+_2 and OH [1], which are respectively shows in Figure 1 and Figure 2. The simulated spectra were calculated to minimize the sum of square error between the measured and the calculated spectra by choosing the best fit for the vibrational and rotational temperatures [2]. The vibrational temperature has been determined from N^+_2 (FNS) for (0, 0) and (1, 1) head bands spectra at 391.4 nm and 388.4 nm respectively [3,4]. The rotational temperature has been determined from OH (0, 0) head bands spectra at 309 nm [5].

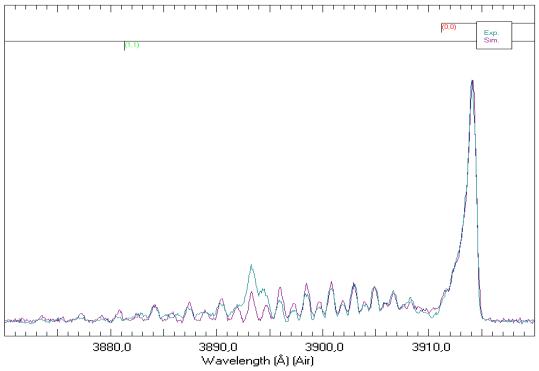

Figure 1. Measured and synthetic spectrum of N^+_2(B-X), vibrational temperature T_{vib}=860K, Va = 6.4kV, f = 10kHz and rate hygrometry of 100%.

2. Effect of operating parameters on the rotational and vibrational temperatures

Based on the above method, the effect of applied voltage, frequency and rate hygrometry on the rotational and vibrational temperatures is studied in this work. As results, the rotational and vibrational temperatures increase versus the applied voltage and rate hygrometry, but the influence of frequency is negligible.

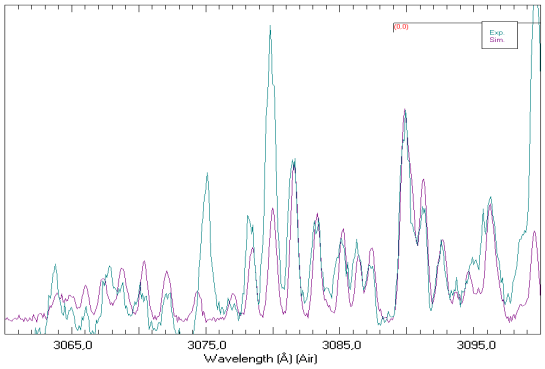

Figure 2. Measured and synthetic spectrum of OH (A-X), rotational temperature T_{rot} = 820K with Va = 6.4kV, f = 10kHz and rate hygrometry of 100%.

3. References

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