RADIAL DISTRIBUTION OF PLASMA ELECTRON DENSITY AND TEMPERATURE IN ATMOSPHERIC PLASMA JET

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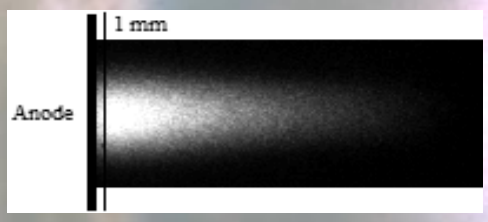
Abstract. Radial distribution of plasma electron density and temperature of atmospheric argon plasma jet were measured by applying spectroscopic method.

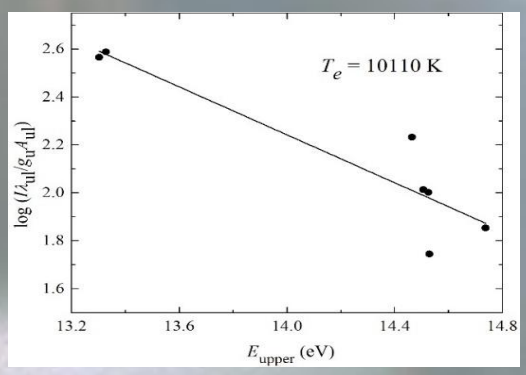
Wall stabilized arc working in argon in DC regime is used in this experiment. The operating DC current through the arc was 32 A. High current pulses were added to the DC current, so the maximal total current in pulses was 180 A and lasted 4 ms. The frequency of the pulses was 1 Hz. The detailed description of this arrangement can be found in Djurovic et al. 2012 and Gajo et al. 2013.

During high current pulses the plasma jet appeared at the exit of the arc column on the side of the anode. The jet spread into free air through the hole in the anode. The jet was observed side-on close to the exit. Radiation from the jet was focused on the entrance slit of 1m-monochromator with 1200 g/mm diffraction grating. At the exit of the monchromator ICCD camera was placed for spectral line recordings. Approximate dimension of the plasma jet is 20 mm in length and 5 mm in diameter close to the arc exit. Spectral recordings were made at the maximum of current pulses about 1 mm far from the arc anode.

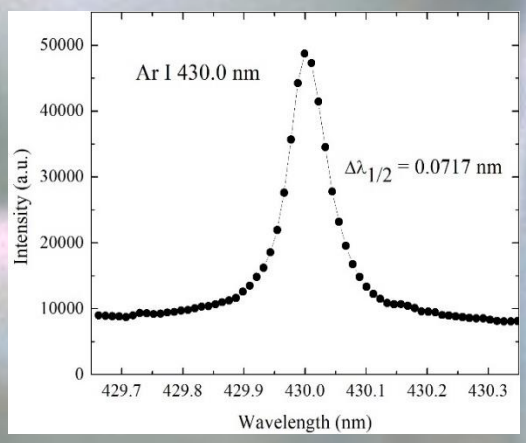


Plasma jet and position of recordings.

The determination of plasma electron temperatures and densities along the radius of the plasma jet was done from Stark widths of Ar I 4300.0 nm and Boltzmann plot using Ar I 415.8, 425.9, 427.2. 430.0, 470.2, 696.5 and 706.7 nm spectral lines.



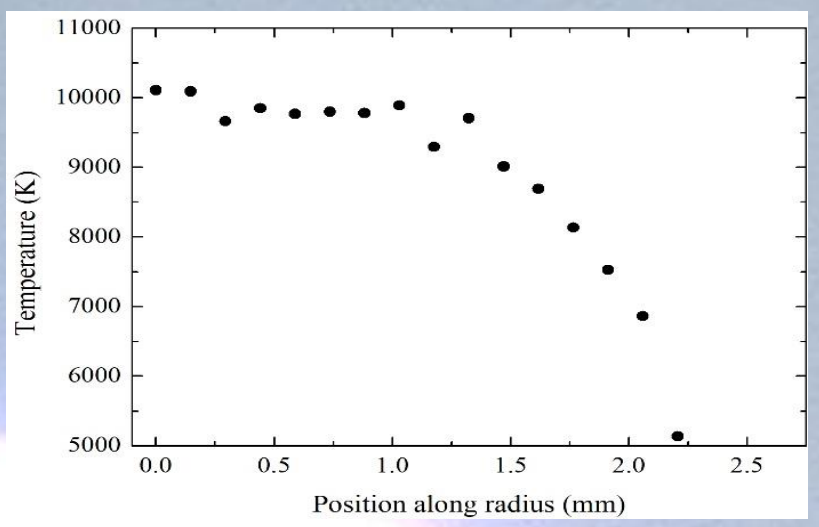
Boltzmann plot using seven Ar I spectral lines.



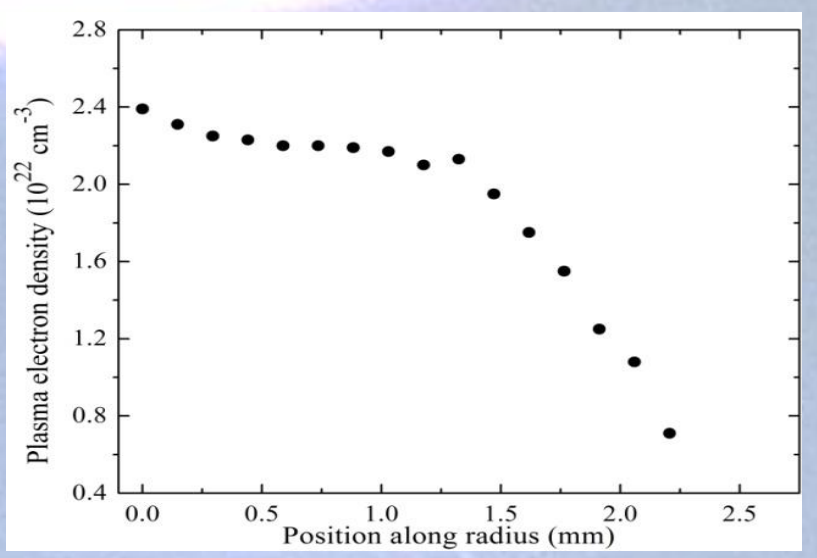
Example of Ar 430.0nm line.

RESULTS

As it can be expected, maximum values of plasma temperature and electron density are around the axis. The temperature profile at around 2 mm from the axis is close to 10000 K. This fact shows that this plasma region, with high plasma temperature, can be used for various plasma applications, like melting materials, powders for coating, plasma reactions, etc. From the comparisons with the values of plasma electron densities and temperatures obtained in Snyder et al. 1994 it can be concluded that they are in reasonable accordance.



Radial distribution of plasma temperature.



Radial distribution of plasma electron density.

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