Diagnostics of vicinity of thermal plasma jet by electric probes

O. Hurba[1,2], M. Hrabovský[1]

[1] *Institute of Plasma Physics AS CR, v.v.i., Prague, Czech Republic*
[2] *Charles University in Prague, Faculty of Mathematics and Physics, Prague, Czech Republic*

Electric probes and double probe have been applied to study an atmospheric pressure thermal plasma jet generated by the torch with water/argon stabilized arc. Different operation modes of the plasma torch were studied. Dependence of properties of the plasma jet on arc electric current, and argon content in the plasma was investigated. The area 9 - 33 cm from the plasma torch was investigated. Floating potential and the extent of conducting area were determined form the measurements. Plasma temperature and the plasma resistance corresponding to measured probe signals were evaluated.

Thermal plasma jets generated in dc arc torches are used in a number of plasma processing applications like plasma spraying, waste treatment and gasification of organics, reforming of hydrocarbons, and plasma cutting and melting. In all these applications the plasma flow interacts with treated material which is introduced into the jet or plasma flow impinges material surface.

The jet dimensions are determined by torch nozzle geometry and size, and by jet expansion in the space after plasma leaves the nozzle. The extent of region of plasma presence can be substantial larger than visible area of plasma jet. The presence of cold gas eddies inside the core of plasma jet, resulting from an entrainment of gas into plasma flow, has been well described [1]. However, little is known about possibility of ejection of plasma eddies from the jet into surrounding gas due to turbulences in the boundary between high velocity, low density plasma flow and steady colder gas surrounding the jet. Although the presence of plasma species around plasma jet can substantially influence interaction of treated material with plasma flow, the region surrounding plasma jet has not been sufficiently studied.

In this paper, electrical single and double probes were used for the investigation of a region surrounding thermal plasma jet generated in hybrid water/argon plasma torch [2]. Figure 1 presents boundaries of conducting region around plasma jet for several arc currents and flow rates of argon.

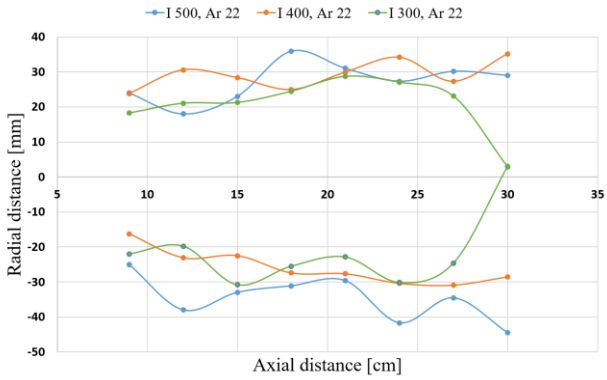

Fig. 1 - Conductive area of plasma torch in operating modes with flow rate of Ar = 22 slm

Floating potential and the plasma temperature corresponding to the probe signals have been evaluated from results of measurements.

Acknowledgement

The authors gratefully acknowledge support of the Grant Agency of CR under the project number GA15-19444S.

References

[1] E. Pfender, Thin Solid Films, 238 (1994) 228-241.

[2] M. Hrabovsky, V. Kopecky, V. Sember, T. Kavka, O. Chumak, IEEE Trans. on Plasma Science, TPS0333, 2004.