# Arc electrode interaction in thermal plasma applications

Dirk Uhrlandt*[1], Guokai Zhang[1], Gregor Gött[1], Margarita Baeva[1], and Sergey Gortschakow[1]

[1]Leibniz Institute for Plasma Science and Technology – Allemagne

**Résumé**

The attachment of the arc at the electrodes and their interaction are of particular importance in all applications of transferred and non-transferred arcs. This is because the current distribution, the energy transfer to the electrodes and often also the main shape of the arc are mainly determined by the processes at and near the electrode surfaces. At the beginning, a rough overview about theoretical concepts to describe the arc-electrode interaction will be given.
It will be demonstrated in a second part that a model based on a non-equilibrium plasma description is able to provide a far-reaching understanding of the simplest case; the free-burning arc in argon with a tungsten cathode. The self-consistent description yields not only the sheath voltages but the complete electric potential structure including the pre-sheath regions. The energy balance of tungsten inert gas welding processes becomes explainable including questions like the energy transfer from sheath regions to the electrodes and to the plasma.

The limitations of existing models to describe an arc between non-refractory electrodes at the same level of detail will be discussed in a third part. Magneto-hydrodynamic models of gas metal arc welding including the description of metal vapor and sheath establishment will be considered as examples.

Recent findings of experimental studies for the sheath voltage in gas metal arc welding will be shown in a fourth part also to demonstrate future needs in modelling. In particular, the current dependence of the sheath voltage and voltage drops in the parts of the electrodes will be discussed.
Finally, a conclusion will be given with the focus on future needs in modelling and possible approaches in particular to treat arcs between non-refractory electrodes as in gas metal arc welding, for example.

*Intervenant