

INFLUENCE OF METALLIC VAPOURS ON ARC PROPERTIES

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The experimental studies carried out over the last few years on thermal plasmas have shown the importance of the presence of metal vapours arising from the electrodes or from the vapourisation of metal particles injected into the plasma. Indeed the physical properties of metal atoms are generally very different from those of the atoms of the plasma gas (ionisation potential, mass). The plasmas formed by these mixtures have properties quite unlike those of the plasmas of the pure gases. Even at low concentrations (0.1 % for example) metal vapours can strongly modify the coefficients of electrical and thermal conductivity and, more generally, the transport coefficients. In particular, the radiation of a plasma can be greatly increased in the presence of certain vapours. These effects do not depend on the vapour alone but also on the gas with which it is mixed.

The modification of the basic properties of the plasma cause the properties of the discharge also to be changed. The presence of metal vapours generally gives rise to a lowering of the local temperature due to a decrease of the power delivered in turn arising from a decrease of the electric field. The study of this process cannot be made without taking the radiated power into account. Certain fluctuations of the electric field observed in the arcs are due to rapid and random emissions of puffs of vapour from the electrode. By modifying the local electrical conductivity, they modify the tension of the arc.

Injection of these vapours into the plasma of the arc occurs through continuous vapourisation and by jets (which can be discontinuous). In all cases, the spatial distribution is governed by diffusion which is not always the same for metal and for gas atoms. This generally gives rise to a lower partial pressure for the metal vapours along the axis of the discharge.

In the energy balance at the electrodes, it is necessary to take the influence of the vapours into account. It must also be taken into account in the calculation of the power received by a particle vapourised in a plasma for plasma projection applications.