Numerical simulation of plasma creation and expansion in an argon arc

Expanding plasma flows can be found in industrial applications like low pressure plasma spraying (LPPS) and plasma chemical vapor deposition (PCVD) as well as in astrophysical and research plasmas. Numerical simulation of expanding plasmas incorporates a number of challenges. First of all the compressible flow field must be described correctly. Secondly, due to the high hydrodynamic speed, the plasma is not likely to be in equilibrium. As a consequence, the different constituents in the plasma will have different temperatures and the chemical composition will not obey the Boltzmann-Saha law.

In this contribution we present non-equilibrium simulations of an expanding argon arc performed with the plasma modeling platform Plasimo. In the simulations both the plasma creation in the argon arc and the consecutive expansion in the vacuum chamber are incorporated in one model. With this integral approach it is possible to model the expansion without a priori knowledge of the Mach number and the profiles of the temperature and the chemical constituents at the inlet of the vacuum chamber.