Investigations of argon arc attachment modes on the anode: the effect of gas temperature

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There are two different kinds of anode arc attachment modes in the free burning arc, i.e., diffuse and constricted arc attachments. In this paper, a 1D two-temperature model coupled with collisional-radiative model is presented to study the effect of gas temperature on the different arc attachment modes. The radial distributions of electron temperature, electron density, excited states densities, ionization and recombination processes are obtained under different arc attachment modes. The simulation results show that the constricted arc attachment mode occurs at a small gas temperature, while at large gas temperature valuesthe diffuse arc attachment is obtained.

The collisional-radiative modelis used in a systematic approach to examine the chemical reactions processes occurring in the anode region, including the arc center and fringe region. The mechanism which results in different arc attachment modes is also investigated. It is found that the dissociative electron-ion recombination plays an important rolein determining the arc attachment modes. At small gas temperature values, the density of argon molecular ion increases, resulting in a larger recombination rate, thus constricted arc attachment mode occurs. The three-body recombination also leads to a decrease in the electron density, but its rate is too low to account for sufficient recombination. Our simulation results reveal the chemical kinetics mechanisms leading to different anode arc attachment modes.

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