INFLUENCE OF PARTICLE MATERIAL EVAPORATION ON HEAT TRANSFER FROM PLASMA TO FINE-SIZED PARTICLES IN PLASMA SPRAYING

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S u m m a r y

Fundamental mechanisms of heat transfer from low-temperature atmospheric pressure plasma to the fine-sized particle are studied under plasma spraying conditions. Analysis of the physical processes occurring within the Knudsen layer near the particle surface resulted in derivation of analytical expressions for evaluating the densities of electron and ion currents from plasma to the particle surface, the potential drop between plasma and the particle, as well as electron and ion components of a heat flux from plasma to the particle. The near-surface plasma is assumed to be non-isothermal and multi-component to contain atoms and ions of the evaporated particle material along with the plasma gas particles. The method of determining parameters of the near-surface plasma at the external boundary of the Knudsen layer, which appear in the derived analytical expressions, is proposed. In a wide range of temperature of the non-disturbed argon plasma and temperature of the aluminum particle surface the numerical analysis of plasma composition, electron temperature and temperature of heavy particles of the near-surface plasma is performed, and the corresponding heat fluxes to the sprayed particle are evaluated. The near-surface plasma which is rendered multi-component due to evaporation of the particle in a diffusion mode is shown to substantially influence the total heat flux from plasma to the particle.