

Estimation of the average ions charge and plasma momentum for vacuum arc plasma

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The parameters of the cathode spot plasma produced by explosive electron emission pulses have been estimated from the critical state properties for various materials [1].

The kinetic energy of the cathode plasma flare has been estimated as $100T_{\text{cr}}$, where T_{cr} is the critical temperature of the cathode material. Based on a Saha-like equation and a two-temperature simulation of the explosion of a liquid-metal micro jet, an estimation formula for the average ion charge has been derived, $Z_{\text{av}} = 1 + T_{\text{cr}}/1 \text{ eV}$, which fits the available experimental data. This has made it possible to explain the linear relationship between average charge and kinetic energy obtained experimentally for the cathode plasma ions. Using this formula, the previously derived expression for the plasma momentum per transferred charge μ has been simplified to become $\mu \sim 5(M_i/M_p)^{1/2} \text{ g cm}/(\text{s C})$, where M_i/M_p is the ion-to-proton mass ratio.

Work was supported in part by the Russian Foundation for Basic Research (grant No.19-08-01249).

Values of critical temperature used herein have been obtained by Academician Professor Vladimir E Fortov, who has suddenly passed away at the end of 2020 and left a scientific legacy in extreme state of matter and plasma physics.

[1] Tsventoukh M M 2021 *Phys. Plasmas* **28** 024501