

## INVESTIGATION OF THE CHARGE STATE VARIATION OF SN IONS IN THE PLASMA OF LOW-CURRENT VACUUM ARC ON A TIN CATHODE\*

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Investigations of variation of the ion charge composition in low current vacuum arc plasma have both theoretical and practical importance. In a fundamental physics area, data of the investigations help to develop a model of plasma generation by cathode explosive emission centers in vacuum discharges. And for practical applications, it is useful to find a range of applicability for the classical data [1] about the charge composition of ions in the vacuum arc plasma, which were obtained in current ranges of tens and hundreds of amperes.

A decrease in the average charge of the ions of the cathode material with a decrease in the vacuum arc current was noted by several researchers. We studied this effect in detail for copper cathodes in the course of several experiments at various parameters. Also, this effect was confirmed for composite cathodes made of CuCr material and for refractory cathodes using molybdenum as an example. In the course of this study, a tin cathode was chosen as the object. This material differs significantly from the materials mentioned above, both in terms of thermophysical properties and the charge composition of ions in vacuum arc plasma at currents above 100 A. According to classical data, the average charge of tin ions in the vacuum arcs is 1.53, while for copper and chromium this parameter exceeds 2, and for molybdenum it exceeds 3. The charge composition was studied using a Thomson spectrometer with automatic signal recording and digital data processing. The arc discharge was fed by a generator based on an LC line with a quasi-rectangular pulse shape. The arc current was varied in the range from 2 to 125 A. The behavior of the charge composition of the ions of the cathode material in the case of a tin cathode differed significantly from the previously studied materials. The general observation was, that instead of a decrease in the average charge of ions with the arc current, an increase in this parameter was found. In the arc plasma at low currents, the fraction of Sn<sup>3+</sup> ions increased. In the low-current range Sn<sup>4+</sup> ions also appeared, and the fraction of the ions increased with current decrease too, while at discharge currents above 40 A the signal of the Sn<sup>4+</sup> ions was not noticeable against the noise background at all.

### REFERENCES

- [1] A. Anders, "Ion charge state distributions of vacuum arc plasmas: The origin of species," *Physical Review E*, 1997, vol. 55, pp. 969-981.

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