

FOUR-PARAMETER MODEL FOR A FEE SIGNAL

Andrey Antonov, Nikolay Egorov, Marina Varayun'

Saint Petersburg State University, Saint Petersburg, 199034, Russia, n.v.egorov@spbu.ru

ABSTRACT

In the research, the dependence of the current on the voltage with four parameters is considered as a regression model. Obviously, a growing class of emission materials and conditions for their usage take us further and further beyond the classical theory of field electron emission [1]. Also in the literature one can observe not only experimental deviations of the current-voltage characteristic from a straight line in the Fowler—Nordheim coordinates [2, 3], but also theoretical backgrounds for this fact [4, 5]. As an alternative to the traditional two-parameter model [6], it is fair to pay attention to some models with more parameters [7].

In this investigation, we propose to consider one four-parameter model for which the Fowler—Nordheim formula is a special case, of course. Thus, the additional modifications are necessary for the further analysis only if they have shown their statistical significance. Proposed formalization of the response type can contribute for more accurate construction of confidence intervals for signal (current) measurements. The same relates to the prediction of current-voltage observations for values that are not included in the data sample (i.s. to the extrapolation).

Acknowledgments: The reported study was funded by RFBR, project number 20-07-01086.

References

- [1] N. EGOROV, E. SHESHIN, *Field Emission Electronics*, Springer Series in Advanced Microelectronics 60 (Springer International Publishing, 2017) 568 p.
- [2] F. GIUBILEO, A. Di BARTOLOMEO, L. IEMMO et al. *Field Emission from Self-Catalyzed GaAs Nanowires*, *Nanomaterials* 7(9) (2017) 275.
- [3] I. RAWAL, L. KUMAR, R. K. TRIPATHI, O. S. PANWAR, *Surface Structure-Dependent Low Turn-On Electron Field Emission from Polypyrrole/Tin Oxide Hybrid Cathodes*, *ACS Omega* 2(11) (2017) 7515.
- [4] N.V. EGOROV, A.A. ALMAZOV, *Optimization of multi-tip field emission electron source*, *Vacuum* 52 (1999) 295.
- [5] J. HE, P.H. CUTLER, N.M. MISKOVSKY, *Generalization of Fowler—Nordheim field emission theory for nonplanar metal emitters*, *Appl. Phys. Lett.*, 59(13) (1991) 1644.
- [6] N.V. EGOROV, A.Yu. ANTONOV, M.I. VARAYUN', *Analysis of the Emission Characteristics of Field Cathodes Using Regression Models*, *Journal of Surface Investigation: X-ray, Synchrotron and Neutron Techniques* 12 (2018) 1005.
- [7] A. Yu. ANTONOV, M.I. VARAYUN', N.V. EGOROV, *Linearized Three-Parameter Regression Model for the Field Electron Emission Signal*, *Nano- and Microsystems Technology* 21(2) (2019) 103.