

COMBINED TREATMENT OF ELECTRODES AS A MEANS OF INCREASING THE ELECTRICAL STRENGTH OF VACUUM INSULATION

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One of the methods for increasing the electrical strength of vacuum insulation is the preliminary polishing of the electrodes with a low-energy high-current electron beam (LEHCEB) [1]. A specially selected mode allows us to evaporate or dissolve a significant part of the foreign inclusions in the near-surface volume of the electrode, and make the surface itself smooth. Such treatment allows to increase the pulsed electrical strength of millimeter vacuum gaps to values exceeding 1 MV/cm. However, these values remain more than an order of magnitude less than the theoretically achievable limit which due to the onset of intense field emission from a smooth and chemically pure homogeneous metal surface. A probable reason for this limitation is residual dielectric or semiconductor inclusions fixed in the matrix of the substance, creating triple points on which the electric field is concentrated.

Earlier, we pointed out the possibility of selective removal of the initial surface inclusions by separate short-pulse conditioning of stainless steel electrodes under plasma [2]. After finishing treatment the conditioned electrodes by the LEHCEB, the results were contradictory. Despite the fact that the average value of the pulsed electrical strength of the vacuum gaps practically did not change, the spread of this value increased so much that individual vacuum gaps showed record high values close to 2 MV/cm. This indicated the possibility of further work to improve the quality of vacuum insulation. Based on the short-pulse plasma conditioning method developed in [2], in this paper, additional actions were taken to stabilize the pulsed electrical strength of vacuum gaps at relatively high levels close to 2 MV/cm.

REFERENCES

- [1] A.Batrakov, D.Nazarov, G.Ozur, S.Popov, D.Proskurovsky, and V.Rotshtein. IEEE Trans. Dielectr. Electr. Insul., V. 4, pp. 857–862, 1997.
- [2] E.V. Nefedtsev, S.A. Onischenko, G.E. Ozur, D.I. Proskurovsky, “Improvement of Electrical Insulation in Vacuum by Comprehensive Treatment of Electrodes under Plasma”, Proc. of 28th International Symposium on Discharges and Electrical Insulation in Vacuum (ISDEIV), pp.97-100, 2018.