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MODELING OF TRANSIENTS IN A DISCHARGE-PULSE SYSTEM FOR PROCESSING GRANULATED CONDUCTIVE MEDIA USING A REFINED DEPENDENCE OF THEIR RESISTANCE ON TIME

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Abstract

The time dependences of the resistance of plasma-erosive load are investigated. For the first time, two new characteristic area of the first mode of this dependence were revealed. As a result of their analysis, the phenomenon of re-appearance of streamer and leader plasma channels after the disappearance of most of the previously formed plasma channels has been substantiated. Taking into account two new characteristic area of the first mode, the dependence of the resistance of the plasma-erosive load on time, its refined parametric model was created. The values of the parameters of this model that are optimal by the criteria of the three main parameters of the residual of the approximation are found. Functions that approximate the dependence of these parameters on the amplitude of the voltage pulses applied to the load are proposed and the optimal values of their coefficients are found. In the

Mathlab Simulink software package a model of a discharge-pulse system with a refined parametric model of plasma-erosive load was created and transients in it were calculated. An assessment is made of the adequacy of transient simulation compared with real processes. Ref erences 18, figures 4, tables 4.

Key words: plasma-erosive load, parametric model, discharge-pulse system, transients, adequacy.

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References

1. Goncharuk V.V., Shcherba A.A., Zakharchenko S.N., Savluk O.S., Potapchenko N.G., Kosinova V.N. Disinfectant action of the volume electrospark discharges in water. *Khimiia i tekhnologiia vody*. 1999. No 3. Vol. 21. Pp. 328-336. (Rus)

2. Greshilov A.A., Stakun V.A., Stakun A.A. Mathematical methods of construction of prognoses. Moskva: Radio i Sviaz, 1997. 112 p. (Rus)

3. Danilenko N.B., Galanov A.I., Kornev Ya.I., Balukhtin P.V., Shyian L.N., Yurmazova T.A., Yavorovskii N.A., Savelev G.G. Application of pulsing electric discharges in aqueous solutions for production of nano-size materials and their use for water purification. *Nanotekhnika*. 2006. No 4(8). Pp. 81-90. (Rus)

4. Zhiltsov A.V., Korobskyy V.V., Lapshin S.O., Olishevskyy V.V. Use of the electrotechnical complex for nano and micro-powders of metal. *Science Journal of NUBiP Ukraine. A series of Technology and energy in agriculture*. 2018. Vol. 268. Pp. 189-196. (Ukr)

5. Zakharchenko S.N., Kondratenko I.P., Perekos A.E., Zalutsky V.P., Kozyrsky V.V., Lopatko K.G. The influence of the duration of discharge pulses in the layer of iron granules on the size and structural-phase state of its electric-erosion particles. *East-European Journal of Enterprise Technologies*. 2012. Vol. 6. No 5 (60). Pp. 66-72. (Rus)

6. Kucheriava I.M. Multiphysics processes at spark erosion treatment of conducting granules. *T ekhnichna Elektrodynamika*. 2017. No 5. Pp. 32-38. (Rus) DOI: https://doi.org/10.15407/techned2017.05.032

7. Shydlovskaya N.A., Zakharchenko S.N., Cherkassky A.P. The Analysis of Electromagnetic Processes in Output Circuit of the Generator of Discharge Pulseshttps://dx.doi.org/10.1063/1.4764017 with Non-linear Model of Plasma-erosive Load at Change Their Parameters in Wide Ranges. *Tekhnichna Elektrodynamika*. 2016. No 1. Pp. 87-95. (Rus) DOI: https://doi.org/10.15407/techned2016.01.087

8. Shydlovskaya N.A., Zakharchenko S.N., Cherkasskyi A.P. Non-linear-parametrical Model of Electrical Resistance of Conductive Granulated Media for a Wide Range of Applied Voltage. *Tekhnichna Elektrodynamika*. 2014. No 6. Pp. 3-17. (Rus)

9. Shydlovska N.A., Zakharchenko S.M., Cherkaskyi O.P. Parametric Model of Resistance of Plasma-erosive Load, Adequate in the Wide Range of Change of Applied Voltage. *Tekhnichna Elektrodynamika*. 2017. No 3. Pp. 3-12. (Ukr) DOI: https://doi.org/10.15407/techned2017.03.003

10. Shydlovska N.A., Zakharchenko S.M., Cherkaskyi O.P. Comparison of the smoothing efficiency of signals of voltage on the plasma-erosive load and its current by multi-iterative filtration methods. *Tekhnichna Elektrodynamika*. 2017. No 4. Pp. 3-13. (Ukr). DOI: https://doi.org/10.15407/techned2017.04.003

11. Shcherba A.A., Podoltsev A.D., Kucheryavaya I.N. Research of the electro-erosive phenomena at a flow of a pulsing current between conductive granules taking into account a plasma contact gap. *Tekhnichna Elektrodynamika*. 2002. No 4. Pp. 3-7. (Rus)

12. Shcherba A.A., Suprunovska N.I. Cyclic transients in the circuits of electric discharge installations taking into account the influence of magnitude and rate of discharge currents rise on resistance of electric spark load. *Tekhnichna Elektrodynamika*. 2018. No 2. Pp. 3-10 (Rus) DOI: https://doi.org/10.15407/techned2018.02.003

13. Shcherba A.A., Suprunovska N.I., Ivashchenko D.S. Modeling of nonlianer resistance of electro-spark load for synthesis of discharge circuit of capacitor by time parameters. *Tekhnichna Elektrodynamika*. 2014. No 3. Pp. 12-18. (Rus)

14. Shcherba A.A., Suprunovskaya N.I., Ivashchenko D.S. Modeling of nonlinear resistance of electro-spark load taking into account its changes during discharge current flowing in the load and at zero current in it. *Tekhnichna Elektrodynamika*. 2014. No 5. Pp. 23-25 (Rus)

15. Kornev Ia., Osokin G., Galanov A., Yavorovsky V., Danilenko N. Pulsed Electrical Discharges in a Layer of Metallic Pieces and their Application for Water Treatment. *Third International Forum on Strategic Technologies*. High Voltage Research Institute of Tomsk Polytechnic University, Tomsk, Russia. 2008. Pp. 516-518.

16. Kornev Ia., Saprykin F., Lobanova G., Ushakov V., Preis S. Spark erosion in a metal spheres bed: Experimental study of the discharge stability and energy efficiency. *Journal of Electrostatics*.

2018. Vol. 96. Pp. 111-118. DOI: https://doi.org/10.1016/j.elstat.2018.10.008
17. Liu Y., Li X., Li Y., Zhao Zh., Bai F. The lattice distortion of nickel particles generated by spark discharge in hydrocarbon dielectric mediums. *Applied Physics A*. 2016. Vol. 122. Pp. 174-1 - 174-9. DOI: https://doi.org/10.1007/s00339-016-9698-2
18. Perekos A.E., Chernenko V.A., Bunayev S.A., Zalutskiy V.P., Ruzhitskaya T.V., Boitsov O.F., Kakazei G.N. Structure and Magnetic Properties of Highly Dispersed Ni-Mn-Ga Powders Prepared by Spark-erosion. *Journal of Applied Physics*. 2012. Vol. 112. Pp. 093909-1 – 093909-7. DOI: https://dx.doi.org/10.1063/1.4764017 .

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