

DOI: <https://doi.org/10.15407/techned2016.01.087>

THE ANALYSIS OF ELECTROMAGNETIC PROCESSES IN OUTPUT CIRCUIT OF THE GENERATOR OF DISCHARGE PULSES WITH NON-LINEAR MODEL OF PLASMA-EROSIVE LOAD AT CHANGE THEIR PARAMETERS IN WIDE RANGES

Journal	Tekhnichna elektrodynamika
Publisher	Institute of Electrodynamics National Academy of Science of Ukraine
ISSN	1607-7970 (print), 2218-1903 (online)
Issue	№ 1, 2016 (January/February)
Pages	87 – 95

Authors

N.A. Shydlovska, S.M. Zakharchenko, O.P. Cherkassky

Institute of Electrodynamics National Academy of Science of Ukraine,
pr. Peremohy, 56, Kyiv-57, 03680, Ukraine,
e-mail: shydlovska@mail.ua, snzakhar@bk.ru, cherksa@bk.ru

Abstract

In program medium Matlab Simulink modeling of transients in an output circuit of the generator of discharge pulses with non-linear model of plasma-erosive load adequate in wide ranges of change of their parameters is completed. As a result of modeling time dependences and also dependences of basic parameters of discharge pulses and their derivatives from amplitude of voltage of pulses and values of jet devices of an output circuit of the generator are gained and analyzed. Time dependences and dependences from amplitudes of voltage of pulses value of the charges which have transited through plasma channels and a hydraulic medium are calculated for the first time. On the basis of the analysis of dependences of their relations a

ranges of change of voltage and duration of pulses in which specific electrochemical activity of current is minimally are found. The card of electrical modes of plasma-erosive processing of the granulated conductive medium and recommendations about control of a grain-size composition of plasma-erosive particles are elaborated. References 18, figures 10, table 1.

Key words: nonlinear resistance, discharge pulses, granular conductive media, plasma channels, modeling.

Received: 12.06.2015

Accepted: 30.12.2015

Published: 29.01.2016

References

1. Lopatko K.G., Melnichuk M.D. Physics, synthesis and biological functionality of nanosize objects. Kyiv: Vydavnychiy tsentr Natsionalnoho Universytetu Bioresursiv i Pryidokorystuvannia Ukrainy, 2013. 297 p. (Ukr)
2. Shydlovskaya N.A., Zakharchenko S.N., Cherkassky A.P. Model of an output circuit of the discharge pulses generator with a plasma-erosive load adequate in wide range of changes of their parameters. *Tekhnichna Elektrodynamika*. 2015. No 6. P. 69–77. (Rus)
3. Shydlovskaya N.A., Zakharchenko S.N., Cherkassky A.P. Nonlinear-parametrical model of electrical resistance of conductive granulated media for a wide range of applied voltage. *Tekhnichna Elektrodynamika*. 2014. No 6. P. 3–17. (Rus)
4. Shcherba A.A., Zakharchenko S.N., Lopatko K.G., Aftandilyants E.G. Application of volume electric spark dispersion for production steady to sedimentation hydrosols of biological active metals. *Pratsi Instytutu Elektrodynamiky Natsionalnoi Akademii Nauk Ukrainy*. 2009. No 22. P. 74–79. (Rus)

5. Shcherba A.A., Zakharchenko S.N., Lopatko K.G., Shevchenko N.I., Lomko N.A. Discharge-pulsing systems of production of nano-colloidal solutions of biologically active metals by a method of volumetric electric-spark dispersing. *Pratsi Instytutu Elektrodynamiky Natsionalnoi Akademii Nauk Ukrainy*. 2010. No 26. P. 152–160. (Rus)
6. Shcherba A.A., Zakharchenko S.N., Yatsyuk S.A., Kucheryavaya I.N., Lopatko K.G., Aftandilyants E.G. Analyze of methods of raise of efficiency of electric-erosive coagulation for purification of water media. *Tekhnichna Elektrodynamika. Tematychnyi vypusk Sylova elektronika ta enerhoefektyvnist*. 2008. Part 2. P. 120–125. (Rus)
7. Berkowitz A.E., Hansen M.F., Parker F.T., Vecchio K.S., Spada F.E., Lavernia E.J., Rodriguez R. Amorphous soft magnetic particles produced by spark erosion. *J. Magn. Magn. Mater*. 2003. No 1. P. 254–255. DOI: [https://doi.org/10.1016/S0304-8853\(02\)00932-0](https://doi.org/10.1016/S0304-8853(02)00932-0)
8. Berkowitz A.E., Walter J.L. Spark Erosion: A Method for Producing Rapidly Quenched Fine Powders. *Journal of Materials Research*. 1987. No 2. P. 277–288. DOI: <https://doi.org/10.1557/JMR.1987.0277>
9. Carrey J., Radousky H.B., Berkowitz A.E. Spark-eroded particles: influence of processing parameters. *J. Appl. Phys.* 2004. Vol. 95. No 3. P. 823–829. DOI: <https://doi.org/10.1063/1.1635973>
10. Danilenko N.B., Savel'ev G.G., Yavorovskii N.A., Yurmazova T.A. Chemical reactions in electric pulse dispersion of iron in aqueous solutions. *Russian Journal of Applied Chemistry*. 2008. Vol. 81. No 5. P. 803–809. DOI: <https://doi.org/10.1134/S1070427208050157>
11. Hong J.I., Parker F.T., Solomon V.C., Madras P., Smith D.J., Berkowitz A.E. Fabrication of spherical particles with mixed amorphous/crystalline nanostructured cores and insulating oxide shells. *J. Mater. Res*. 2008. Vol. 23. No 6. P. 1758–1763. DOI: <https://doi.org/10.1557/JMR.2008.0199>
12. Hong J.I., Solomon V.C., Smith D.J., Parker F.T., Summers E.M., Berkowitz A.E. One-Step Production of Optimized Fe-Ga Particles by Spark Erosion. *Appl. Phys. Lett.* 2006. Vol. 89. P. 142506-1 – 142506-3.
13. Hsu M.S., Meyers M.A., Berkowitz A.E. Synthesis of Nanocrystalline Titanium Carbide by Spark Erosion. *Scripta Metallurgica et Materialia*. 1995. Vol. 32. P. 805–808. DOI: [https://doi.org/10.1016/0956-716X\(95\)93205-I](https://doi.org/10.1016/0956-716X(95)93205-I)
14. Kolbasov G.Ya., Ustinov A.I., Shcherba A.A., Perekos A.Ye., Danilov M.O., Vyunova N.V., Zakharchenko S.N., Hossbah G. Application of volumetric electric-spark dispersion for the fabrication of Ti-Zr-Ni hydrogen storage alloys. *Journal of Power Sources*. 2005. Vol. 150. P. 276–281. DOI: <https://doi.org/10.1016/j.jpowsour.2005.02.025>
15. Nguyen P.K, Jin S., Berkowitz A.E. Mn-Bi particles with high energy density made by spark erosion. *J. Appl. Phys.* 2014. Vol. 115. Pp. 17A756-1 – 17A756-3.

16. Nguyen P.K., Lee K.H., Kim S.I., Ahn K.A., Chen L.H., Lee S.M., Chen R.K., Jin S., Berkowitz A.E. Spark erosion: a high production rate method for producing Bi_{0.5}Sb_{1.5}Te₃ nanoparticles with enhanced thermoelectric performance. *Nanotechnology*. 2012. Vol. 23. P. 415604-1 – 415604-7.
17. Perekos A.E., Chernenko V.A., Bunyaev 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. *J. Appl. Phys.* 2012. Vol. 112. P. 093909-1 – 093909-7.
18. Tang Y.J., Parker F.T., Harper H., Berkowitz A.E., Jiang Q., Smith D.J., Brand M., Wang F. Co₅₀Fe₅₀ Fine Particles for Power Frequency Applications. *IEEE Trans. Magn*. 2004. Vol. 40. No 4. P. 2002–2004. DOI: <https://doi.org/10.1109/TMAG.2004.832505>

[PDF](#)