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# Dependence of the operation of the cardioelectrode on the properties of coatings deposited by plasma methods

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***Method for measuring the cardioelectrodes coatings properties deposited by plasma methods is presented. The measurement technique allows determine the efficiency of charge transfer, impedance, depolarization time, as well as the nonlinear dependences of these characteristics on the supplied potential and pulse duration. Coatings deposited by plasma methods have a multilayer structure and a developed surface (large effective surface area of $S_{eff}$). The described technique also allows determine the $S_{eff}/S$ ratio. The scanning electron microscopy studies of the electrode surface are compared with the measured values of $S_{eff}$. Thus for Pt-coated cathode, the dependence of the described electrical characteristics on the duration of the stimulation pulse was obtained. The measurement results also allow determine the response of the cardioelectrode-electrolyte system to stimulation pulses and the value of the effective cathode area. This result coincided with the results obtained by scanning electron and atomic force microscopy.***

*Keywords*: pacemaker, electrodes, double electric layer, impedance, specific surface area.

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REFERENCES

1. Bokeria O. L. Pacing. Great Russian Encyclopedia.
2. Schaldach M., Electrotherapy of the Heart, Springer, March 10, 1992.
3. Double electric layer. Physical Encyclopedic Dictionary. Moscow: Soviet Encyclopedia, 1960.
4. Dubrovskiy I. A., Meditsinskaya tekhnika, № 4, 21 (2010).
5. Lau E. W., Clinical Cardiac Pacing, Defibrillation and Resynchronization Therapy, Elsiver, 2017.
6. Sekhushin N. A., J. Izvestiya Komi, № 4 (4), 22 (2010).
7. Pospisil L. and de Levie R., Electroanal. Chem. **22**, 227 (1969).
8. Creager S. E. and Wooster T. T., Anal. Chem. **70**, 4257 (1998).
9. Carnie S. E. and Tome G. M., Advances in Chemical Physics. **56**, 141 (1984).
10. Attard P., Advances in Chemical Physics **92**, 1 (1996).
11. Hamelin A., Mod. Asp. Electrochem. **16**, 1 (1985).
12. Ruderman A., Juarez M. F., Soldano G., Avalle L. B., Beltramo G., Giesen M. and Santos E., Electrochim. Acta. **109**, 403 (2013).
13. Bard A. J. and Faulkner L. R., Controlled-current techniques. In Electrochemical methods: fundamentals and applications, ed 2, New York, 2001.
14. Sarabia F. G., Climent V. and Feliu J. M., Chem. Phys. Chem. (2019). doi: 10.1002/cphc.201900543
15. Damaskin B. and Frumkin A., Electrochim. Acta. **19**, 173 (1974).
16. Schmickler W. and Henderson D. J., Chem. Phys. **85**, 1650 (1986).
17. Fisicaro G., Genovese L., Andreussi O., Mandal S., Nair N., Marzari N. and Goedecker S., J. Chem. Theory Comput. **13**, 3829 (2017).
18. Sundararaman R. and Schwarz K., J. Chem. Phys. **146**, 084111 (2017).
19. Sundararaman R., Letchworth-Weaver K. and Schwarz K., J. Chem. Phys. **148** (14), 144105 (2018).
20. Kolovos-Vellianitis D. and Küppers J., Surf. Sci. **548** (1), 67 (2004).
21. Demyan V. V., Fedorovich R. A. and Mikhailenko V. D., Sb. statei XXXII Mezhdunarodnoi nauchno-prakticheskoi konferentsii “Advances in Science and Technology”, Moscow, 2020, pp. 41–43.
22. Obrezkov O. I., Bazylev V. A., Martynenko Yu. V. and Nagel M. Yu., Meditsinskaya tekhnika, № 1, 331 (2022).
23. Damaskin D. D., Petrii O. A. and Tsirluna G. A., Electrochemistry, Moscow «Khimiya», 2006.
24. Salem R. R., Theory of double layer, Moscow, “Fizmatlit”, 2003.