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# ELECTROSPINNIG OF POLYHETEROARYLENES FOR NEW NANOFIBER FUNCTIONAL MATERIALS

**Iv I Ponomarev[1,2], I I Ponomarev[2], D Yu Razorenov[2], K M Skupov[2], O M Zhigalina[2], Yu A Volkova[2], V G Zhigalina[2], Yu M Volfkovich[2]** and **V E Sosenkin[2]**

[1]ELMARCO s.r.o., Czech Republic
[2]Russian Academy of Sciences, Russia

Nanostructured materials based on aromatic heterocyclic polymers, polyheteroarylenes (PHA) are now widely common in photovoltaics, membrane technologies, sensor and electrochemical devices, etc. New PHAs convertible by electrospinning to nanofiber mats are demanded on modern state of nanotechnology for example as high performance carbonaceous material of gas diffusion electrodes (GDE) for hydrogen-air polymer electrolyte membrane fuel cell (PEMFC). The spinnability of polyheteroarylenes was not a subject of large investigations. The process of PHA electrospinning is a very challenging task. There are no general methods which would allow obtaining an electrospun material certainly. Failing to find a right set of electrospinning conditions may lead to the impossibility of nanofiber formation. Hence, many parameters of the electrospinning process should be found empirically, which in some cases is a long and routine process. Only few papers describe nanofiber materials based on some polyimides, m-polybenzimidazole (m-PBI) and semi-ladder PIM-1 obtained only on so called "needle" setups. Elmarco's first "needle-free" electrospinning equipment Nanospider™ is proved by industrial operation; a technology based on spinning from a free liquid surface. Needle-free process guarantees optimal distance between Taylor cones, excellent web and fiber uniformity, simplicity of design, robustness against clogging of a spinneret, increased productivity due to the simultaneous operation of numerous jets. The lecture will be devoted to the production of new high-tech PHAs nanofibers and non-woven materials eminently suitable for electrochemical applications.

## Recent Publications:

1. Skupov K M, Ponomarev I I, Razorenov D Yu, Zhigalina V G, Zhigalina O M, *et al.* (2017) Carbon nanofiber paper cathode modification for higher performance of phosphoric acid fuel cells on polybenzimidazole membrane. Russian Journal of Electrochemistry 53(7):728–733.
2. Zhigalina V G, Zhigalina O M, Ponomarev I I, Skupov K M, Razorenov D Yu, *et al.* (2017) Electron microscopy study of new composite materials based on electrospun carbon nanofibers. Cryst Eng Comm. (RSC) 19(27):3792–3800.
3. Skupov Kirill M, Ponomarev Igor I, Razorenov Dmitry Y, Zhigalina Viktoria G, Zhigalina Olga M, *et al.* (2017) Carbon nanofiber paper electrodes based on heterocyclic polymers for high temperature polymer electrolyte membrane fuel cell. Macromol. Symp. 375(1):1600188–92.
4. Razorenov Dmitry Y, Skupov Kirill M, Volkova Yulia A, Ponomarev Ivan I, Chaika Elena M, *et al.* (2017) Poly(N-phenylenebenzimidazoles): a new approach for monomer synthesis. Macromol. Symp. 375(1):1600152–59.
5. I I Ponomarev, K M Skupov, D Yu Razorenov, V G Zhigalina, O M Zhigalina, *et al.* (2016) Electrospun nanofiber pyropolymer electrodes for fuel cells on polybenzimidazole membranes. Russ J Electrochem 52:735.

## Biography

Ivan Ponomarev PhD. is the Head of Chemistry and Technology Department at ELMARCO s.r.o. (Czech Republic). He obtained master degree from Russian University of Chemical Technology, Moscow, Material technology and new composite material technology in the academic year 2001–2007. His master degree work was partially carried out at A N Nesmeyanov Institute of Organo-element Compounds Russian Academy of Sciences. He received PhD. Degree from A N Nesmeyanov Institute of Organoelement Compounds Russian Academy of Sciences, Moscow in the year 2007–2010. Main topic: Synthesis of high-tech polymers for fuel cells, design of membrane electrode assemblies. From 2005–2010 he worked as Researcher at A N Nesmeyanov Institute of Organoelement Compounds, Russian Academy of Sciences, where he worked on the synthesis of high-tech polymers for fuel cells, management of project part, design of membrane electrode assembly. His research interests include electrospinning, synthesis and modification of heterocyclic polymers and new nanomaterial creation. In 2010 Ivan started his career as R&D project manager at Elamrco company - world leader in industrial nanofiber equipment production based on patented Nanospider™ technology. Since 2015 Mr. Ponomarev is leading Chemistry & Technology department at Elmarco.

ivan.ponomarev@elmarco.com