Mikhail M. Petrov

PhD (2019), MSCA Postdoctoral Fellow

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Personal data

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Research Profile

With a background in electrochemistry (flow batteries, electromediated reactions, electroactive polymers) and training in soft matter physics, I'm now shifting into microbial electrochemistry. My main project designs carbon-based materials with immobilized redox mediators for biomethanation. At the same time, I'm involved in developing dual-flow batteries that integrate energy storage with water electrolysis, as well as creating "living cement" with supercapacitor properties. Fascinated by the marriage of electrical currents and living matter, I see electrobiotechnology as a promising path toward a more sustainable future.

Methodological expertise: Electrochemical measurements, Battery testing, Electrochemical reactor engineering, Anaerobic Enrichment, Polymeric material synthesis; Analytical techniques, Data analysis.

Education

2019	Ph.D., Faculty of Physics, Polymer Physics (Electrochromic polymers). Supervisor: Elena E. Makhaeva	Moscow State University
2012	Specialist, Faculty of Physics, Condensed matter physics	Moscow State University

Academic appointments

2023 - Pr.	Marie-Sklodowska Curie fellow (earlier – Postdoc) with Anders Bentien and Michael Kofoed, Department of Biological and Chemical Engineering.	Aarhus University
2017-23	Group leader and senior lecturer (earlier – research engineer), Laboratory of Chemical Power Sources and Electroactive Materials	Mendeleev University of Chemical Technology
2019-20	Junior researcher with Mikhail A. Vorotyntsev, Center for novel and mobile energy technologies	Institute of Problems of Chemical Physics RAS

Fundings Obtained

2024-26	Marie-Sklodowska Curie fellowship (230.000 €). Personal grant. Bioelectrochemical Systems with Immobilized Redox Mediators for Power-to-Methane Conversion.
2022-23	Initiative project of Mendeleev University (~30.000 €). PI. Flow-type microbial fuel cells.
2021-23	Russian Science Foundation grant (~35.000 €). PI. Anthraquinone organic flow batteries

2021-23	President's scholarship (~12.000 €). Personal grant. Anthraquinone organic electrolytes.
2014-15	Grant program UMNIK (~15.000 €). Personal grant. Developing smart windows
2014-15	LG Chem Scholarship (~2.000 €). Personal grant. Electrochromic interpolymer complexes

Honors and Awards

2022	Special mention by the jury of the Ars Electronica Festival 22. Scientific supervisor of the interdisciplinary project "Feral Automated System: ULTB-1".
2020	*ChemPlusChem* readers' choice. (10.1002/cplu.202000519)
2019	Poster award at the XXVI International conference "Lomonosov"
2017, 2016	Tech in media winner. Award for science-popular journalism

Leadership and management experience

2024 – present. MSCA postdoctoral project at Aarhus University

- Led the conceptualization and execution of an independent interdisciplinary research project
- Managed project reporting to the European Commission

2021 – 2023. Group leader at Mendeleev University

- As a project manager, I led a research lab of 1 senior researcher, 4 postdocs, 4 PhD students and 2 MSc students, developing various flow batteries (vanadium, organic, hybrid). Annual budget of ~ 400.000 €
- Launched a master's degree program in electrochemical energy systems, annual cohort of 7 students
- Secured and led several side-stream research projects

Teaching and mentoring

2023 - Pr.	Co-supervision of a PhD student from the A. Bentien group. Metal-organic electrolytes for dual flow batteries	Aarhus University
2025	Co-supervised 2 MSc students from the A. Bentien group, Prototyping dual flow system	Aarhus University
2023	Invited lecturer at MSc course "Conceptions and methods of modern science", Art&Science Center	ITMO University
2021-22	Supervised 2 MSc students from the Laboratory of Chemical Power Sources and Electroactive Materials, Organic electrolytes for flow batteries	Mendeleev University
2021	Developed and taught a high-school course on Microbial Fuel Cells	Educational Centre Sirius
2021-23	Co-authored and taught MSc courses "Electrochemical measurements" and "Energy cells"	Mendeleev University
2013	Assistant at a bachelor's lab course on Mechanics, Faculty of Physics	Moscow State University

Collaborations and Research Network

2025 - Pr.	Dr. Qi Luo. Supercapacitive biohybrid material with electroactive microorganisms.	Aarhus University and RWTH Aachen University
2025 - Pr.	Dr. Josh Bailey. Interlaboratory testing of all-iron flow batteries	Quinn's University Belfast
2023 - Pr.	Dual flow batteries to couple energy storage and electrolysis/electrosynthesis via mediators	Dual Flow Consortium
2022-23	Prof. E. Skorb, soft electroactive materials for novel energy storage concepts	ITMO University
2021-22	Prof. A. Adamatzky, blending non-conventional computing and energy storage	Bristol University

Partnerships with industry

2021 – 2023. Mendeleev University & InEnergy group

- Project manager of R&D contract on rebalancing system for vanadium flow battery.
- Project manager of R&D contract on impurities in vanadium electrolytes for flow batteries.

Selected patents

- Battery device for membrane-electrode blocks of the flowing battery. RU-patent #197738
- Device for measuring the crossover of electroactive substances through a membrane. RU-patent #193033
- Spectrophotometric flow cell design. RU-patent #186501
- Microbial fuel cell for generating electricity from wastewater, Ru-patent #2809834

Academic Service

2022 - Pr.	Reviewer for journals ~ 50 reviews in total	Journal of Power Sources, Journal of Energy Storage, International Journal of Hydrogen Energy, Electrochimica Acta, Electrochemistry Communications, Energy, Batteries & Supercaps, Frontiers in Microbiology, etc.
2025	Oral presenter	University journal club on CO_2 reduction, Aarhus University
2021, 2022	Co-organizer	Summer schools EMCPS 21 and EMCPS 22 (Electrochemical Materials and Chemical Power Sources), Moscow, Russia.

Science communications and public outreach. Selected

2021- 23	Science advisor of the science art project	"*Unstable Connections*". A series of workshops, lectures and site-specific installations. Final part presented at Ars Electronica Festival 2022 (Linz, Austria). Followed by two academic publications (1, 2)
2022	Video interview	"*The era of large batteries*" featured in *Scientific Russia*.
2021	Workshop	Designing soil-based microbial fuel cells. Cultural project "*Grounding*" at Art.ITMO.Residency (Saint-Petersburg, Russia)
2021	Public lecture	"*Five stories about mud*". Polytechnic Museum (Moscow, Russia)

2020	Follow-up press-release	Featured paper in ChemPlusChem (10.1002/cplu.202000519) See the Altmetric details.
2019	Workshop	Designing sedimentary microbial fuel cells. Public program "*After Petropolitics*" in Garage Museum, Moscow, Russia.

Selected Publications

2025

1. Luo Q, Li Z, Li Y, **Petrov M**. Living microbial cement supercapacitors with reactivatable energy storage. *Cell Reports Physical Science*. Accepted for publication
2. Chikin D, **Petrov M**, Loktionov P, Pichugov R, Antipov A. Boosting the performance of a zero-gap flow microbial fuel cell by immobilised redox mediators. *ChemPlusChem*. 10.1002/cplu.202400586

2024

3. **Petrov MM**, Chikin DV, Karpenko KA, Antipova LZ, Loktionov PA, Pichugov RD, Karastsialiova AR, Vereshchagin AN, Antipov AE. Tuning the composition of mixed anthraquinone derivatives towards an affordable flow battery negolyte. *Journal of Electroanalytical Chemistry*. 10.1016/j.jelechem.2024.118693
4. Berdiyeva P, Oreiro SN, Fenini F, **Petrov M**, Rahimi M, Papaharalabos G, Bentien A. Facile and robust assessment of membrane transport properties in the course of standard electrochemical tests of vanadium redox flow batteries. *Journal of Power Sources*. 10.1016/j.jpowsour.2024.234974

2023

5. Loktionov P, Konev D, Pichugov R**, Petrov M**, Antipov A**.** Calibration-free coulometric sensors for operando electrolytes imbalance monitoring of vanadium redox flow battery. *Journal of Power Sources*. 10.1016/j.jpowsour.2022.232242
6. Pichugov RD, Loktionov PA, Pustovalova AA, Glazkov AT, Grishko AY, Konev DV, **Petrov MM**, Usenko A A, Antipov AE. Restoring the capacity and efficiency of vanadium redox flow battery via controlled adjustment of electrolyte composition by electrolysis cell. *Journal of Power Sources.* 10.1016/j.jpowsour.2023.233013

2022

7. Loktionov P, Pichugov R, Konev D, **Petrov M**, Pustovalova A, Antipov A**.** Operando UV/Vis spectra deconvolution for comprehensive electrolytes analysis of vanadium redox flow battery. *Journal of Electroanalytical Chemistry*. 10.1016/j.jelechem.2022.116912
8. **Petrov M**, Chikin D, Abunaeva L, Glazkov A, Pichugov R, Vinyukov A, Levina I, Motyakin M, Mezhuev Y, Konev D., Antipov A. Mixture of anthraquinone sulfo-derivatives as an inexpensive organic flow battery negolyte: optimisation of battery cell. *Membranes*. 10.3390/membranes12100912

2021

9. Modestov AD, Andreev VN, Antipov AE, **Petrov MM**. Novel aqueous zinc–halogenate flow batteries as an offspring of zinc–air fuel cells for use in oxygen-deficient environment. *Energy Technology*. 10.1002/ente.202100233
10. Loktionov P, Bocharova A, Konev D, Modestov A, Pichugov R, **Petrov M**, Antipov A. Two-Membrane Acid-Base Flow Battery with Hydrogen Electrodes for Neutralization-to-Electrical Energy Conversion. *ChemSusChem*. 10.1002/cssc.202101460
11. **Petrov M**, Modestov A, Konev D, Antipov A, Loktionov P, Pichugov R, Kartashova N, Glazkov A, Abunaeva L, Andreev V, Vorotyntsev M. Redox flow batteries: role in modern electric power industry and comparative characteristics of the main types. *Russian Chemical Reviews*. 10.1070/RCR4987

2020

12. Pichugov R , Konev D, **Petrov M**, Antipov A, Loktionov P, Abunaeva L, Usenko A, Vorotyntsev M. Electrolyte

Flow Field Variation: a cell for testing and optimisation of membrane electrode assembly for vanadium redox flow batteries. *ChemPlusChem*. 10.1002/cplu.202000519

2019

13. **Petrov M**, Konev D, Kuznetsov V, Antipov A, Kartashova N, Vorotyntsev M. Electrochemically driven evolution of Br-containing aqueous solution composition. *Journal of Electroanalytical Chemistry*. 10.1016/j.jelechem.2019.05.125

2018

14. Frolov D, **Petrov M**, Makhaeva E, Keshtov M, Khokhlov A. Electrochromic behaviour of poly(pyridinium triflates) films: Electrolyte ions influence. *Synthetic Metals*. 10.1016/j.synthmet.2018.03.001Petrov M,
15. Konev D, Antipov A, **Petrov M**, Shamraeva M, Vorotyntsev M. Surprising dependence of the current density of bromate electroreduction on the microelectrode radius as manifestation of the autocatalytic redox-cycle (EC″) reaction mechanism. *Electrochemistry Communications*. 10.1016/j.elecom.2017.11.006
16. Modestov A, Konev D, Antipov A, **Petrov M**, Pichugov R, Vorotyntsev M. Bromate electroreduction from sulfuric acid solution at rotating disk electrode: experimental study. *Electrochimica Acta*. 10.1016/j.electacta.2017.10.199

2016

17. **Petrov MM**, Makhaeva EE, Frolov DG, Keshtov ML, Khokhlov AR. Electrochromism of interpolyelectrolyte poly(pyridinium) films with varying hydrophobicity of counterions. *Organic Electronics*. 10.1016/j.orgel.2016.03.042

2014

18. **Petrov M.,** Makhaeva E., Keshtov M., Khokhlov A. The effect of poly(N-vinylcaprolactam) on the electrochromic properties of a poly(pyridinium triflate). *Electrochimica Acta.* 10.1016/j.electacta.2013.09.013

Selected Conferences

1. **Petrov M**, Hohn AOE, Danielsen OH, Ethelberg JV, Bentien A. All-iron flow battery coupled with room temperature hydrogen production. (2025) International Flow Battery Forum 2025, Vienna, Austria. **Oral**
2. **Petrov M**, Kofoed MVW, Bentien A. Bypassing the limits of hydrogen solubility in biomethanation with conductive materials and redox mediators. (2025) Conference of the International Society for Microbial Electrochemistry and Technology ISMET 9, Leipzig, Germany. **Poster**
3. **Petrov M**, Kofoed MVW, Bentien A. Some like it conductive? On the possibility of increasing biomethanation efficiency using carbon materials. (2025) Electromicrobiology 2025, Aarhus, Denmark. **Poster**
4. **Petrov M**, Hohn AOE, Rahimi M, Bentien A. Titanium organometallic complexes as a promising redox mediator for producing hydrogen in redox flow batteries. (2023). International Flow Battery Forum 2023, Prague, Czech Republic. **Poster**
5. Chikin DV, Abunaeva LZ, Glazkov AT, Karpenko KA, **Petrov MM**. High-power and inexpensive organic negolyte for redox flow battery based on anthraquinone sulfo-derivatives mixture. (2022). International Conference on Nanomaterials and Advanced Energy Storage Systems INESS22, Nur-Sultan, Kazakhstan. **Oral**
6. **Petrov MM**, Pichugov RD, Frolov DG, Antipov AE, Makhaeva EE. Study of the relationship between the electrochromic properties of poly(pyridinium) triflate salts and their ionic and electronic conduction systems. (2019) the XXVI International conference “Lomonosov”, Moscow, Russia. **Poster Award**
7. Antipov A, Konev D, **Petrov M,** Pichugov R, Vorotyntsev M. Surprising Dependence of the Current Density of Bromate Electroreduction on the Microelectrode Radius as Manifestation of the Autocatalytic Redox-Cycle

(EC") Reaction Mechanism (2018). The 69th Annual Meeting of the International Society of Electrochemistry, Bologna, Italy. **Oral**

8. **Petrov MM**, Pichugov RD, Makhaeva EE. Electrochromic properties of Poly(pyridinium triflate/Poly (styrene sulfonate) interpolymer complex. (2014) XII International Fall School on Organic Electronics IFSOE 2014, Moscow Region, Russia. **Oral**

References

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