Theme: Electrochemistry in Energy: Fuel Cells and Batteries

Electrochemistry and Energy Storage Applications of Graphene and Its Derivatives

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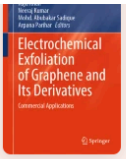
pp 217–239 | Cite this chapter



Electrochemical Exfoliation of Graphene and Its Derivatives

Gaurav Tatrari, Mayank Pathak, Diksha Bhatt, Kamal Garwal, Faiz Ullah Shah & Nanda Gopal Sahoo

Part of the book series: Engineering Materials ((ENG.MAT.))

Abstract

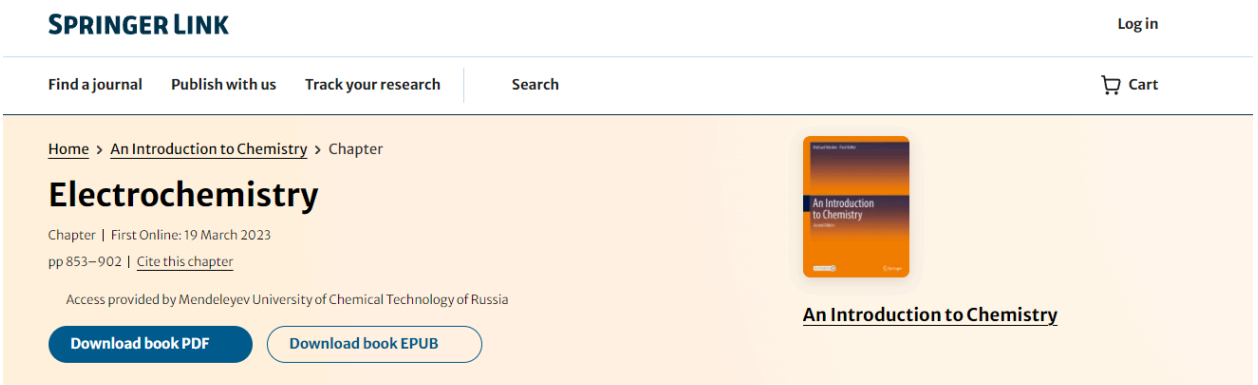
The energy demand cannot be fully accomplished as the rate of increasing worldwide population is larger than the production of energy. The increasing population also leads to the development of more electrical components, which need a lot of energy to store, so energy storing devices are the need of the hour. Batteries and supercapacitors are the main class of such energy storage devices. Graphene is a 2D nanomaterial suitable for energy storage devices as electrode material due to its remarkable properties like high theoretical specific surface area and high electrical conductivity. Still, scientific works are underway to

Selected contributions in advanced batteries, accumulators, and fuel cells

Tomas Kazda & Marie Sedlarikova

Brno University of Technology, Faculty of Electrical Engineering and Communication, has been involved in the research of materials for electrochemical power sources for more than 50 years. In connection with these research activities, the *Department of Electrical and Electronic Technology* initiated in the year 2000 a series of internationally oriented conferences under the name "*Advanced Batteries, Accumulators, and Fuel Cells*". They focus on advances in science and technology in the field of electrochemical processes and energy storage (batteries, accumulators, supercapacitors, and fuel cells), energy generation from renewable sources, photovoltaic systems, nanomaterials for electrochemical power sources, and aspects of corrosion. Every year, the latest discoveries and trends are added to the conference program.

Electrochemistry

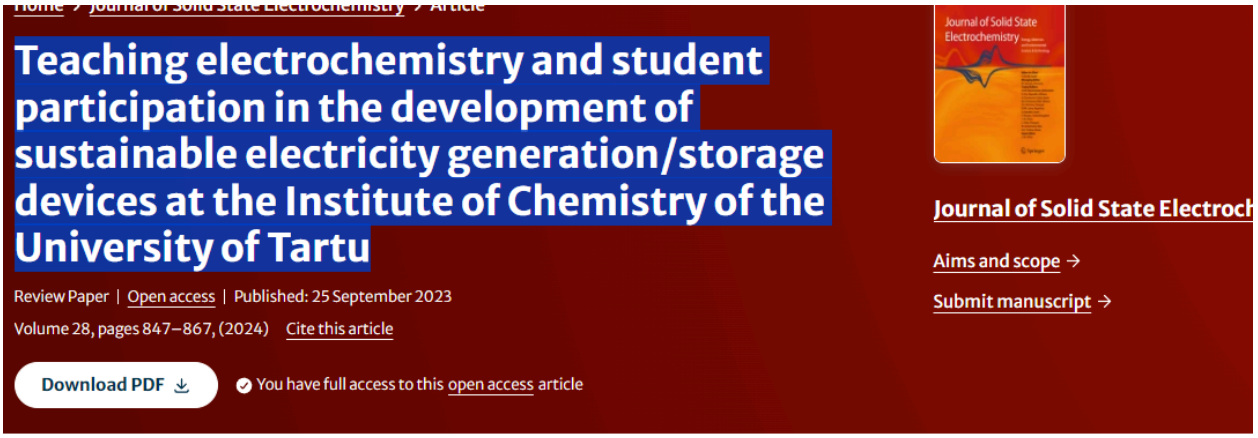


Michael Mosher & Paul Kelter

Abstract

Electrochemistry concerns the electron exchanges that occur in chemical reactions. Understanding the theory and wide-ranging applications of electrochemistry allows us to dive into reduction and oxidation reactions, the relationship of electron exchange to thermodynamics, especially free energy, how electron exchange is related to the concentration of reactants, and how we can change the reaction conditions to generate electricity for uses as varied as heart pacemakers and batteries for electric vehicles.

Teaching electrochemistry and student participation in the development of sustainable electricity generation/storage devices at the Institute of Chemistry of the University of Tartu



H. Ers, P. Pikma, R. Palm, M. Paalo, A. Jänes, T. Thomberg, M. Härmas, R. Härmas, L. Kalder, L.-K. Salvan, P. Teppor, R. Jäger, H. Kasuk, J. Nerut, S. Sepp, G. Nurk, K. Lust & E. Lust

Abstract

Research-based education is a long-standing tradition at the University of Tartu (UT). Basic knowledge of electrochemistry and the principles of developing electrochemical devices have been taught and implemented at UT since 1960. For instance, during then, self-made alkaline electrolysers were used to generate hydrogen. The hydrogen was further purified and used to saturate aqueous and non-aqueous electrolytes. The

Solid-State Electrochemistry and Solid Oxide Fuel Cells: Status and Future Prospects

Solid-State Electrochemistry and Solid Oxide Fuel Cells: Status and Future Prospects

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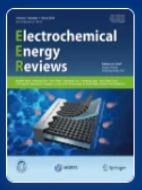

Electrochemical Energy Review

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San Ping Jiang

Abstract

Solid-state electrochemistry (SSE) is an interdisciplinary field bridging electrochemistry and solid-state ionics and deals primarily with the properties of solids that conduct ions in the case of ionic conducting solid electrolytes and electrons and/or electron holes in the case of mixed ionic and electronic conducting materials. However, in solid-state devices such as solid oxide fuel cells (SOFCs), there are unique electrochemical features due to the high operating temperature (600–1 000 °C) and solid electrolytes and electrodes. The solid-to-solid contact at the electrode/electrolyte interface is one of the most distinguished features of SOFCs and is one of the fundamental reasons for the occurance of most importance phenomena such as shift of the equipotential lines, the constriction effect, polarization-induced interface formation, etc. in SOFCs. The restriction in placing the reference electrode in solid electrolyte cells further complicates the SSE in SOFCs. In

Gaurav Tatrari

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Energy Storage Devices Electrolyte Development Electrode Modification Waste Management Graphene

TITLE	CITED BY	YEAR
Solid waste-derived carbon nanomaterials for supercapacitor applications: a recent overview G Tatrari, M Karakoti, C Tewari, S Pandey, BS Bohra, A Dandapat, ... Materials Advances 2 (5), 1454-1484	70	2021
A simple, eco-friendly and green approach to synthesis of blue photoluminescent potassium-doped graphene oxide from agriculture waste for bio-imaging applications C Tewari, G Tatrari, M Karakoti, S Pandey, M Pal, S Rana, ... Materials Science and Engineering: C 104, 109970	41	2019
A waste to energy approach for the effective conversion of solid waste plastics into graphene nanosheets using different catalysts for high performance supercapacitors: a … M Karakoti, S Pandey, G Tatrari, PS Dhapola, R Jangra, S Dhali, ... Materials Advances 3 (4), 2146-2157	38	2022

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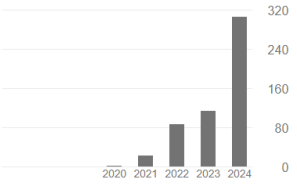

Mayank Pathak

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Postdoctoral Researcher, University of Texas at El Paso
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Supercapacitors Li-ion battery Carbon nanomaterials Graphene Electrolytes

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A waste to energy approach for the effective conversion of solid waste plastics into graphene nanosheets using different catalysts for high performance supercapacitors: a … M Karakoti, S Pandey, G Tatrari, PS Dhapola, R Jangra, S Dhali, ... Materials Advances 3 (4), 2146-2157	38	2022
Mass production of metal-doped graphene from the agriculture waste of Quercus ilex leaves for supercapacitors: inclusive DFT study G Tatrari, C Tewari, M Karakoti, M Pathak, R Jangra, B Santhibhushan, ... RSC advances 11 (18), 10891-10901	28	2021
High energy density supercapacitors: an overview of efficient electrode materials, electrolytes, design, and fabrication M Pathak, D Bhatt, RC Bhatt, BS Bohra, G Tatrari, S Rana, MC Arya, ... The Chemical Record 24 (1), e202300236	25	2024

Cited by

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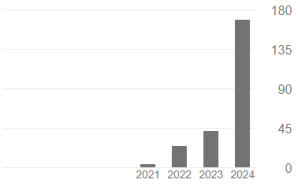
Citations	240	240
h-index	10	10
i10-index	11	11



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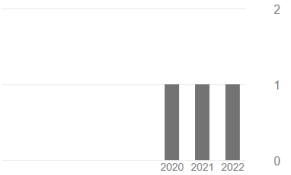
A study of Indian banking sector P Antil, P Antil, K Aggarwal International Journal of Multidisciplinary Research and Development 4 (6 …	4	2017
" Are they Financially well ? Decoding Financial Well Being of Indian Gig Workers " RA A.Kamal , Sharma Vaibhav Empirical Economics Letters,20 (Special issue) 22 (2), 1-12		2023
FINTECH IN INDIA: - OPPORTUNITIES AND THREATS B Saluja, K Agarwal, YVR Murthy Journal of the Oriental Institute 71 (03), 57-61		2022
GREEN BANKING BENEFITS AND CHALLENGES S Gupta, K Agarwal, YVR Murthy JOURNAL OF MANAGEMENT & ENTREPRENEURSHIP 16 (2), 53-56		2022

Cited by

	All	Since 2019
Citations	4	3
h-index	1	1
i10-index	0	0



Electrochemistry Communications

COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
United States Universities and research institutions in United States Media Ranking in United States	Chemistry └ Electrochemistry	Elsevier Inc.	213

PUBLICATION TYPE	ISSN	COVERAGE	INFORMATION
Journals	13882481	1999-2023	Homepage How to publish in this journal Contact

SCOPE

Electrochemistry Communications is an open access journal providing fast dissemination of short communications, full communications and mini reviews covering the whole field of electrochemistry which merit urgent publication. Short communications are limited to a maximum of 20,000 characters (including spaces) while full communications and mini reviews are limited to 25,000 characters (including spaces). Supplementary information is permitted for full communications and mini reviews but not for short communications. We aim to be the fastest journal in electrochemistry for these types of papers.

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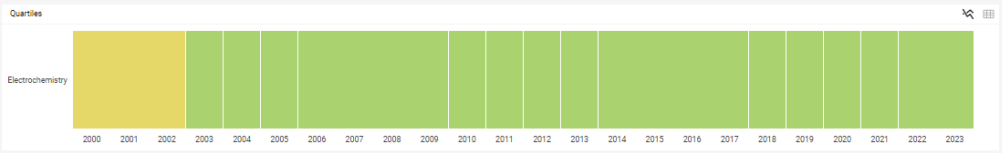

Journal of Applied Electrochemistry

COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
Netherlands Universities and research institutions in Netherlands Media Ranking in Netherlands	Chemical Engineering └ Chemical Engineering (miscellaneous) Chemistry └ Electrochemistry Materials Science └ Materials Chemistry	Springer Netherlands	126

PUBLICATION TYPE	ISSN	COVERAGE	INFORMATION
Journals	0021891X, 15728838	1971-2023	Homepage How to publish in this journal

SCOPE

The Journal of Applied Electrochemistry is the leading journal on technologically orientated aspects of electrochemistry. The interface between electrochemical science and engineering is highlighted, emphasizing the application of electrochemistry to technological development and practice, and documenting properties and data of materials; design factors, design methodologies, scale-up, economics and testing of electrochemical devices and processes. The broad range of technologies includes energy conversion, conservation, and storage, new battery systems, fuel cells, super capacitors, solar cells, power delivery, industrial synthesis, environmental remediation, cell design, corrosion, electrochemical reaction engineering, medical applications of electrochemistry and bio-electrochemistry, the electrochemical treatment of effluents, hydrometallurgy, molten salt and solid state electrochemistry, surface finishing, electroplating, electrodeposition, sensors, and applications of molecular electrochemistry. It also publishes invited reviewed articles, book reviews and news items and a comprehensive electrochemical events calendar.

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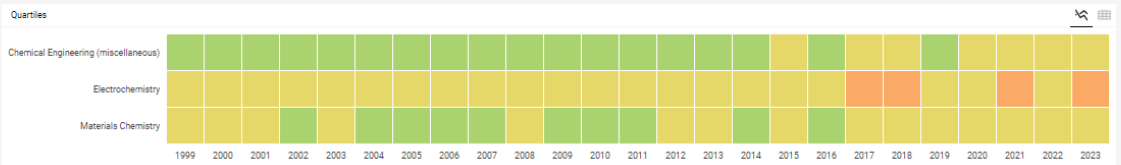

Bioelectrochemistry

COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
Netherlands Universities and research institutions in Netherlands Media Ranking in Netherlands	Biochemistry, Genetics and Molecular Biology └ Biophysics Chemistry ├ Electrochemistry └ Physical and Theoretical Chemistry Medicine └ Medicine (miscellaneous)	Elsevier B.V.	111

PUBLICATION TYPE	ISSN	COVERAGE	INFORMATION
Journals	15675394, 1878562X	2000-2024	Homepage How to publish in this journal

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An International Journal Devoted to Electrochemical Aspects of Biology and Biological Aspects of Electrochemistry Bioelectrochemistry is an international journal devoted to electrochemical principles in biology and biological aspects of electrochemistry. It publishes experimental and theoretical papers dealing with the electrochemical aspects of: • Electrified interfaces (electric double layers, adsorption, electron transfer, protein electrochemistry, basic principles of biosensors, biosensor interfaces and bio-nanosensor design and construction. • Electric and magnetic field effects (field-dependent processes, field interactions with molecules, intramolecular field effects, sensory systems for electric and magnetic fields, molecular and cellular mechanisms) • Bioenergetics and signal transduction (energy conversion, photosynthetic and visual membranes) • Biomembranes and model membranes (thermodynamics and mechanics, membrane transport, electroporation, fusion and insertion) • Electrochemical applications in medicine and biotechnology (drug delivery and gene transfer to cells and tissues, iontophoresis, skin electroporation, injury and repair). • Organization and use of arrays in-vitro and in-vivo, including as part of feedback control. • Electrochemical interrogation of biofilms as generated by microorganisms and tissue reaction associated with medical implants.

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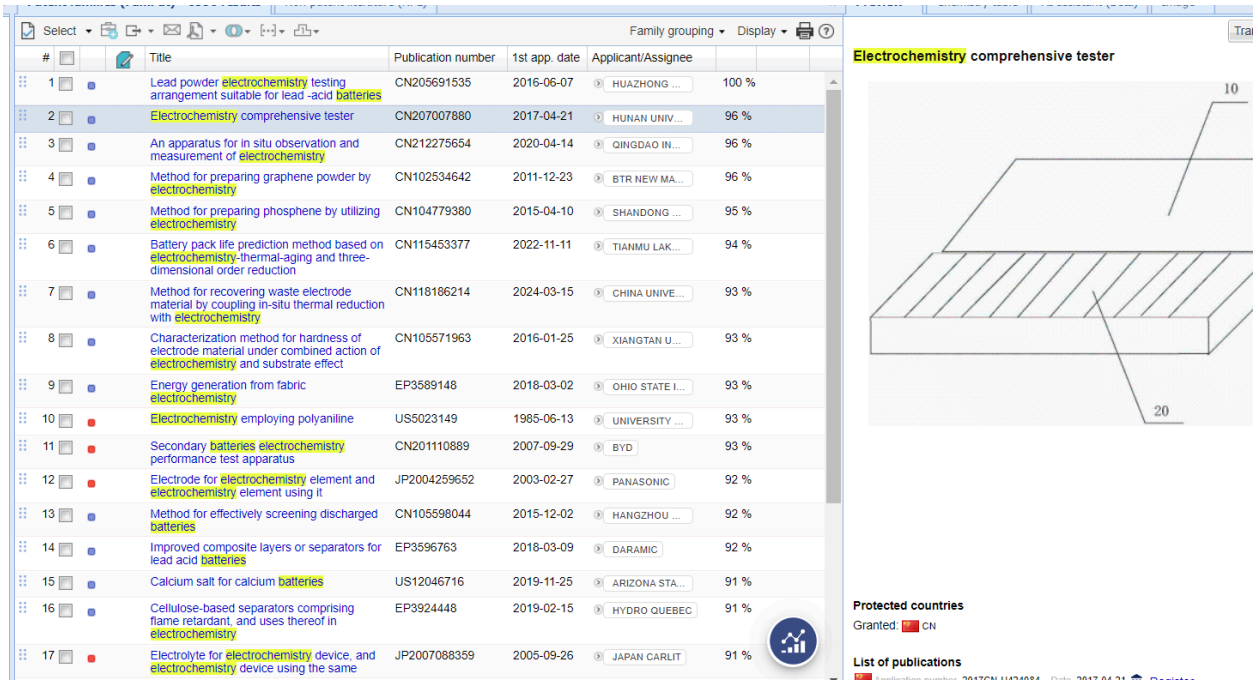

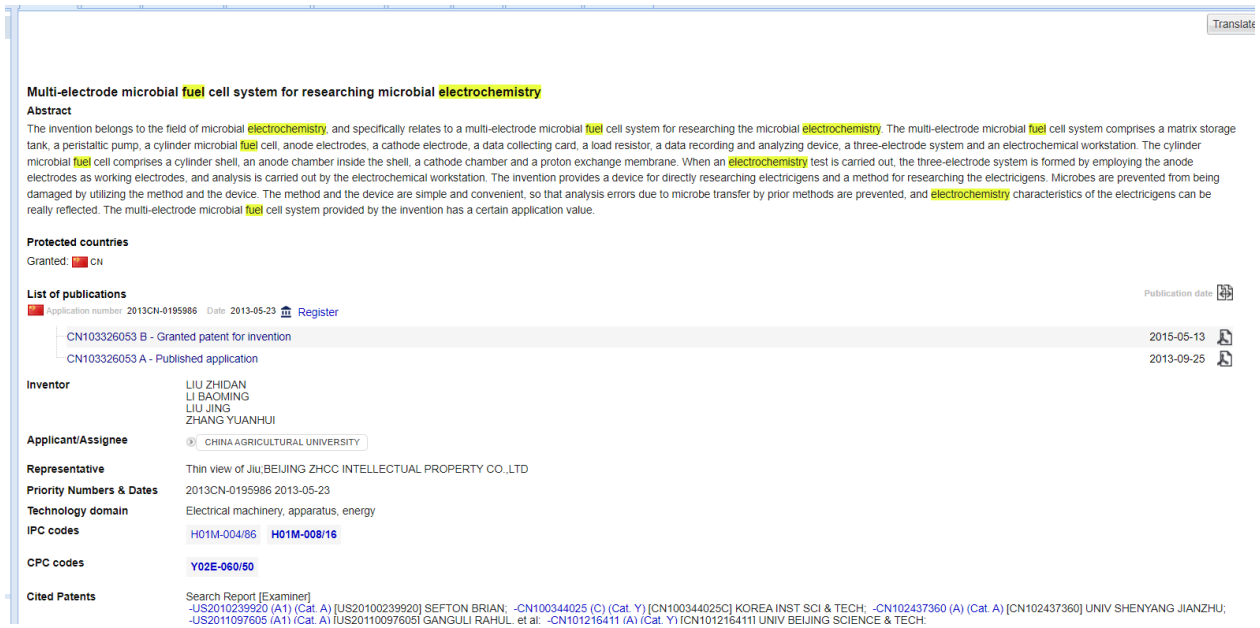

Translate

Multi-electrode microbial fuel cell system for researching microbial electrochemistry

Abstract

The invention belongs to the field of microbial electrochemistry, and specifically relates to a multi-electrode microbial fuel cell system for researching the microbial electrochemistry. The multi-electrode microbial fuel cell system comprises a matrix storage tank, a peristaltic pump, a cylinder microbial fuel cell, anode electrodes, a cathode electrode, a data collecting card, a load resistor, a data recording and analyzing device, a three-electrode system and an electrochemical workstation. The cylinder microbial fuel cell comprises a cylinder shell, an anode chamber inside the shell, a cathode chamber and a proton exchange membrane. When an electrochemistry test is carried out, the three-electrode system is formed by employing the anode electrodes as working electrodes, and analysis is carried out by the electrochemical workstation. The invention provides a device for directly researching electricigens and a method for researching the electricigens. Microbes are prevented from being damaged by utilizing the method and the device. The method and the device are simple and convenient, so that analysis errors due to microbe transfer by prior methods are prevented, and electrochemistry characteristics of the electricigens can be really reflected. The multi-electrode microbial fuel cell system provided by the invention has a certain application value.

Protected countries

Granted: CN

List of publications Publication date

Application number 2013CN-0195986 Date 2013-05-23 Register

CN103326053 B - Granted patent for invention 2015-05-13

CN103326053 A - Published application 2013-09-25

Inventor LIU ZHIDAN; LI BAOMING; LIU JING; ZHANG YUANHUI

Applicant/Assignee CHINA AGRICULTURAL UNIVERSITY

Representative Thin view of Jiu;BEIJING ZHCC INTELLECTUAL PROPERTY CO.,LTD

Priority Numbers & Dates 2013CN-0195986 2013-05-23

Technology domain Electrical machinery, apparatus, energy

IPC codes H01M-004/86 **H01M-008/16**

CPC codes **Y02E-060/50**

Cited Patents Search Report [Examiner]
-US2010239920 (A1) (Cat. A) [US20100239920] SEFTON BRIAN; -CN100344025 (C) (Cat. Y) [CN100344025C] KOREA INST SCI & TECH; -CN102437360 (A) (Cat. A) [CN102437360] UNIV SHENYANG JIANZHU;
-US2011097605 (A1) (Cat. A) [US20110097605] GANGULI RAHUL. et al; -CN101216411 (A) (Cat. Y) [CN101216411] UNIV BEIJING SCIENCE & TECH;

Вывод:

Поиск на английском языке дал намного больше источников и статей, касающихся электрохимии в сфере энергии, включая батареи и топливные элементы, причём в разных отраслях науки и технологий. За рубежом использование передовых методов, таких как искусственный интеллект, для разработки и оптимизации электрохимических процессов в энергетике является более востребованной темой, чем у нас. Это подтверждается количеством опубликованных исследований и уровнем интереса к ним. Можно заключить, что для данной темы целесообразнее проводить поиск на английском языке, так как она является актуальной и активно исследуемой в настоящее время.