

# ELEKTROMOBILNOST

## UČNI NAČRT PREDMETA/COURSE SYLLABUS

<b>Predmet:</b>	Elektromobilnost
<b>Course title:</b>	Electromobility
<b>Članica nosilka/UL Member:</b>	UL FS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Strojništvo - Razvojno raziskovalni program, druga stopnja, magistrski (od študijskega leta 2024/2025 dalje)	Energetsko strojništvo (smer)	2. letnik	1. semester	obvezni

<b>Univerzitetna koda predmeta/University course code:</b>	0566863
<b>Koda učne enote na članici/UL Member course code:</b>	6008-M

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30		30			65	5

<b>Nosilec predmeta/Lecturer:</b>	Klemen Zelič, Tomaž Katrašnik
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<b>Izvajalci predavanj:</b>	
<b>Izvajalci seminarjev:</b>	
<b>Izvajalci vaj:</b>	
<b>Izvajalci kliničnih vaj:</b>	
<b>Izvajalci drugih oblik:</b>	
<b>Izvajalci praktičnega usposabljanja:</b>	

**Vrsta predmeta/Course type:**

Obvezni strokovni predmet na smeri Energetsko strojništvo, ki je izbirni strokovni predmet na ostalih smereh./Compulsory specialised course in the study of Energy engineering, which is an elective specialised course in other fields of study.

**Jeziki/Languages:**

Predavanja/Lectures:

Slovenščina

Vaje/Tutorial:

Slovenščina

**Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:****Prerequisites:**

Izpolnjevanje pogojev za vpis v Magistrski študijski program II. stopnje Strojništvo - Razvojno raziskovalni program.

Meeting the enrollment conditions for the Master's study programme of Mechanical Engineering - Research and Development program.

**Vsebina:****Content (Syllabus outline):**

## 1. predavanje:

- Primeri elektrificiranih pogonov (hibridni, priključni hibridni, baterijski električni, hibridni z gorivnimi celicami) v prometu in identifikacija ter sistemizacija komponent pogonov
- Umestitev elektromobilnosti v različne poti konverzije energijskih vektorjev

## 2. predavanje:

- Raba energije in neposredni ter posredni izpusti onesnažil pogonov z ozirom na življenjski cikel vozila, konverzijo od vira do koles in konverzijo od rezervoarja za energijo do koles
- Tehnološke smernice in zahteve razvoja elektrificiranih pogonov

## 3. predavanje: Baterije 1:

- Izvedbe baterij, sestavni deli in osnovni transportni ter elektrokemični procesi
- Inercijske baterije (poudarek na litijevih tehnologijah): zasnova,

## 1. Lecture:

- Examples of electrified powertrains (hybrid, plug-in hybrids, battery electric, fuel cell hybrid powertrains) in mobile applications and identification and classification of their components,
- Positioning of electromobility in various conversion paths of energy vectors.

## 2. Lecture:

- Use of energy and direct and indirect emissions of vehicle's powertrains with respect to life cycle of the vehicle, conversion from Well-to-Wheel and conversion from Tank-to-Wheel,
- Technology guidelines and R&D requirements of electrified powertrains.

## 3. Lecture: Batteries 1:

- Types of batteries, constitutive parts and basic transport and electrochemical processes,

<p>procesi in zmogljivosti insercijskih baterij</p> <p>4. predavanje: Baterije 2:</p> <ul style="list-style-type: none"> <li>• Degradacijski procesi v baterijah: identifikacija procesov, osnovni mehanizmi, interakcije mehanizmov in vplivni parametri</li> <li>• Vpliv degradacijskih procesov na varnost baterij</li> <li>• Napredne baterijske tehnologije: pregled tehnologij s kovinsko elektrodo in trdnim elektrolitom ter natrijevih, litij žveplo in drugih naprednih tehnologij</li> </ul> <p>5. predavanje: Baterije 3:</p> <ul style="list-style-type: none"> <li>• Protokoli polnjenja in praznjenja baterij ter povezava z izvedbami in zasnovami baterij</li> <li>• Vpliv načina polnjenja in praznjenja na generacijo toplote in izkoristek baterije</li> <li>• Termoregulacija baterij</li> <li>• Hitro polnjenje baterij: zahteve in omejitve</li> <li>• Diagnostika</li> </ul> <p>6. predavanje: Gorivne celice 1:</p> <ul style="list-style-type: none"> <li>• Izvedbe gorivnih celic, sestavni deli in osnovni transportni ter elektrokemični procesi</li> <li>• Gorivne celice s protonskimi izmenjalnimi membranami: zasnova, procesi in zmogljivosti</li> </ul> <p>7. predavanje: Gorivne celice 2:</p> <ul style="list-style-type: none"> <li>• Degradacijski procesi v gorivnih celicah: identifikacija procesov, osnovni mehanizmi, interakcije mehanizmov in vplivni parametri</li> <li>• Vpliv degradacijskih procesov na varnost gorivnih celic</li> <li>• Termoregulacija gorivnih celic</li> <li>• Druge tehnologije gorivnih celic: poudarek na gorivnih celicah s trdnimi oksidi</li> <li>• Diagnostika</li> </ul> <p>8. predavanje:</p> <ul style="list-style-type: none"> <li>• Ultrakondenzatorji: sestavni deli in osnovni transportni ter</li> </ul>	<ul style="list-style-type: none"> <li>• Insertion batteries (emphasis on Li-ion technologies): design, processes and performances of insertion batteries.</li> </ul> <p>4. Lecture: Batteries 2:</p> <ul style="list-style-type: none"> <li>• Degradation processes in batteries: identification of underlying process, basic mechanisms, interaction between mechanisms and influential parameters,</li> <li>• Influence of degradation processes on battery safety,</li> <li>• Advanced battery technologies: overview of metal electrode and solid electrolyte as well as sodium, lithium sulphur and other advanced technologies.</li> </ul> <p>5. Lecture: Batteries 3:</p> <ul style="list-style-type: none"> <li>• Charging and discharging protocols and interrelation to battery types and designs,</li> <li>• Impact of charging and discharging protocol on heat generation and efficiency of batteries</li> <li>• Thermoregulation of batteries,</li> <li>• Fast charging: requirements and limitations,</li> <li>• Diagnostics.</li> </ul> <p>6. Lecture: Fuel cells 1:</p> <ul style="list-style-type: none"> <li>• Types of fuel cells, constitutive parts and basic transport and electrochemical processes,</li> <li>• Proton exchange membrane fuel cells: design, processes and performances.</li> </ul> <p>7. Lecture: Fuel cells 2:</p> <ul style="list-style-type: none"> <li>• Degradation processes in fuel cells: identification of underlying processes, basic mechanisms, interaction between mechanisms and influential parameters,</li> <li>• Influence of degradation processes on fuel cell safety,</li> <li>• Thermoregulation of fuel cells,</li> <li>• Other fuel cell technologies: emphasis on solid oxide fuel cells,</li> <li>• Diagnostics.</li> </ul>
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<p>elektrokemični procesi</p> <ul style="list-style-type: none"> <li>• Kombinacije različnih elektrokemičnih naprav za optimizacijo gostote moči, gostote energije, življenjske dobe in cene</li> </ul> <p>9. predavanje: Električni stroji:</p> <ul style="list-style-type: none"> <li>• Osnove elektromagnetizma v električnih strojih</li> <li>• Izvedbe električnih strojev</li> <li>• Prednosti in pomanjkljivosti določenih izvedb električnih strojev</li> <li>• Inverterji in osnove krmiljenja električnih strojev</li> <li>• Termoregulacija električnih strojev</li> <li>• Diagnostika</li> </ul> <p>10. predavanje:</p> <ul style="list-style-type: none"> <li>• Modeliranje komponent elektrificiranih pogonskih sistemov vozil: baterij, gorivnih celic, električnih strojev</li> </ul> <p>11. predavanje:</p> <ul style="list-style-type: none"> <li>• Analiza topologij elektrificiranih pogonov vozil (hibridni, priključni hibridni, baterijski električni, hibridni z gorivnimi celicami)</li> <li>• Značilnosti in zmogljivosti različnih topologij elektrificiranih pogonov vozil</li> <li>• Energijski tokovi v elektrificiranih pogonih vozil</li> </ul> <p>12. predavanje: Hibridni in priključni hibridni pogoni:</p> <ul style="list-style-type: none"> <li>• Izzivi in primeri uspešnih integracij električnih pogonov in motorja z notranjim zgorevanjem</li> <li>• Optimiranje porabe energije in izpustov onesnažil z ozirom na namen uporabe, topologijo pogona in značilnosti ter zmogljivosti komponent</li> </ul> <p>13. predavanje:</p> <ul style="list-style-type: none"> <li>• Optimiranje in sistemsko modeliranje elektrificiranih pogonskih sistemov vozil: izbira ustreznih komponent, njihovih moči oz. energij z ozirom na lastnosti vozila in namen uporabe</li> </ul> <p>14. predavanje: Termoregulacija</p>	<p>8. Lecture:</p> <ul style="list-style-type: none"> <li>• Ultracapacitors: constitutive parts and basic transport and electrochemical processes.</li> <li>• Combination of various electrochemical devices to optimize power density, energy density, lifetime and costs.</li> </ul> <p>9. Lecture: Electric machines:</p> <ul style="list-style-type: none"> <li>• Basic electromagnetics in electric machines,</li> <li>• Classification and design of electrical machines,</li> <li>• Advantages and disadvantages of different types of electric machines,</li> <li>• Inverters and control basics of electric machines,</li> <li>• Thermoregulation of electric machines,</li> <li>• Diagnostics.</li> </ul> <p>10. Lecture:</p> <ul style="list-style-type: none"> <li>• Modelling of components of electrified powertrains: batteries, fuel cells, electric machines.</li> </ul> <p>11. Lecture:</p> <ul style="list-style-type: none"> <li>• Analysis of topologies of electrified powertrains (hybrid, plug-in hybrids, battery electric, fuel cell hybrid powertrains),</li> <li>• Performance and characteristics of different topologies of electrified powertrains,</li> <li>• Energy flows in electrified powertrains.</li> </ul> <p>12. Lecture: Hybrid and plug-in hybrid powertrains:</p> <ul style="list-style-type: none"> <li>• Challenges and examples of successful integration of electric drives and internal combustion engines,</li> <li>• Optimisation of energy consumption and exhaust emissions with respect to the intended use of the vehicle, powertrain topology, and characteristics and performances of components.</li> </ul> <p>13. Lecture:</p>
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<p>elektrificiranih pogonov vozil:</p> <ul style="list-style-type: none"> <li>• izbira ustreznih topologij hladilnih sistemov,</li> <li>• izbira ustreznih hladilnih izvedb komponent</li> <li>• minimiranje porabe energije za termoregulacijo pogonskega sistema in potniškega prostora oz. porabe toplote v drugih delih vozila</li> </ul> <p>15. predavanje:</p> <ul style="list-style-type: none"> <li>• Refleksija in povezovanje vsebin</li> <li>• Učinkovitost energijskih pretvorb v različnih elektrificiranih pogonih vozil z ozirom na tip vozila in način uporabe – analiza primerov dobrih praks</li> <li>• Viharjenje na temo učinkovitejših pogonskih sistemov prihodnosti</li> </ul>	<ul style="list-style-type: none"> <li>• Optimisation and system level modelling of electrified powertrains: selection of adequate components, their power and energy outputs with respect to the intended use of the vehicle.</li> </ul> <p>14. Lecture: Thermoregulation of electrified powertrains:</p> <ul style="list-style-type: none"> <li>• Selection of adequate topologies of cooling systems,</li> <li>• Selection of adequate cooling designs of components,</li> <li>• Minimisation of energy consumption for powering thermoregulation system of the powertrain and of the cabin compartment or use of heat or cold in other parts of the vehicle.</li> </ul> <p>15. Lecture:</p> <ul style="list-style-type: none"> <li>• Reflection and integration of content,</li> <li>• Energy conversion efficiency of different electrified vehicle's powertrains with respect to the vehicle type and intended use of the vehicle – analysis of good practices,</li> <li>• Brainstorming on the subject of more efficient propulsion systems of the future.</li> </ul>
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### Temeljna literatura in viri/Readings:

<ol style="list-style-type: none"> <li>1. R O'hayre, SW Cha, W Colella, FB Prinz: Fuel cell fundamentals. John Wiley &amp; Sons, 2016, [COBISS.SI-ID <a href="#">15504667</a>]</li> <li>2. Mench, M.M. Fuel cell engines. Wiley, 2008, [COBISS.SI-ID <a href="#">23203111</a>]</li> <li>3. Guzzella L, Sciarretta A.: Vehicle Propulsion Systems - Introduction to Modeling and Optimization, 2nd ed., Springer, 2007, ISBN 978-3-540-74691-1, [COBISS.SI-ID <a href="#">11212571</a>]</li> </ol>
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### Cilji in kompetence:

Cilji in kompetence:	Objectives and competences:
<p>Cilji:</p> <ol style="list-style-type: none"> <li>1. Razumeti teoretične osnove na področju elektromobilnosti in elektrificiranih pogonskih sistemov vozil</li> <li>2. Spoznati umestitev elektromobilnosti v različne poti konverzije energijskih vektorjev</li> <li>3. Spoznati procese in dejavnike staranja v relevantnih komponentah</li> </ol>	<p>Objectives:</p> <ol style="list-style-type: none"> <li>1. Understand the theoretical foundations in the field of electromobility and electrified vehicle propulsion systems</li> <li>2. To know to classify electromobility in various conversion paths of energy vectors</li> <li>3. To know processes and stressors in relevant components of electrified</li> </ol>

<p>elektrificiranih pogonskih sistemov vozil</p> <ol style="list-style-type: none"> <li>4. Spoznati interakcije in soodvisnosti različnih komponent elektrificiranih pogonskih sistemov vozil</li> <li>5. Razumeti pristope za modeliranje procesov na ravni komponent in na ravni elektrificiranega pogonskega sistema vozila</li> <li>6. Razumeti pristope in znati snovati učinkovitejše in okolju prijaznejše elektrificirane pogonske sisteme vozil z ozirom na namen uporabe</li> </ol> <p>Kompetence:</p> <ol style="list-style-type: none"> <li>1. Obvladovanje temeljnih teoretičnih in aplikativnih znanj na področju elektromobilnosti (P2-MAG, S2-MAG)</li> <li>2. Sposobnost razumevanja interakcije in soodvisnosti različnih komponent elektrificiranih pogonskih sistemov vozil (P2-MAG)</li> <li>3. Sposobnost fizikalnega, matematičnega in numeričnega modeliranja komponent in sistemov elektrificiranih pogonskih sistemov vozil (P4-MAG)</li> <li>4. Sposobnost kritične presoje in snovanja elektrificiranih pogonskih sistemov vozil z ozirom na namen uporabe, zmogljivosti in mejne vrednosti izpustov onesnažil (S8-MAG)</li> </ol>	<p>vehicle propulsion systems</p> <ol style="list-style-type: none"> <li>4. To know and to understand interactions in interdependencies of different components electrified vehicle propulsion systems</li> <li>5. Understand modelling approaches for simulating components and systems of electrified powertrains</li> <li>6. Understand development approaches and to know how to design more efficient and environmentally friendly electrified vehicle propulsion systems for the intended use of the vehicle</li> </ol> <p>Competencies:</p> <ol style="list-style-type: none"> <li>1. Using the fundamental theoretical and applied knowledge in the field of electromobility (P2-MAG, S2-MAG)</li> <li>2. Mastering understanding of interactions in interdependencies of different components in electrified vehicle propulsion systems (P2-MAG)</li> <li>3. The ability for physical, mathematical and numerical modelling of components and systems of electrified powertrains (P4-MAG)</li> <li>4. The ability to critically evaluate and design electrified powertrains with respect to the intended use, performances and limiting values of pollutant emissions (S8-MAG)</li> </ol>
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### **Predvideni študijski rezultati:**

<p>Znanja:</p> <p>Poglobljeno teoretično, metodološko in analitično znanje z elementi raziskovanja, ki je osnova za zalo zahtevno znanstveno in strokovno delo na področju razvoja, snovanja in diagnostike elektrificiranih pogonskih sistemov vozil.</p> <p>Spretnosti:</p> <p>S1.1 Sposobnost vrednotenja topologij in procesov elektrificiranih pogonskih sistemov vozil.</p> <p>S1.2 Samostojna uporaba pridobljenega</p>	<p>Knowledge:</p> <p>Z1: In-depth theoretical, methodological and analytical knowledge with elements of research, which is the basis for scientific and professional work in the development, design and diagnostics of electrified vehicle propulsion systems.</p> <p>Skills:</p> <p>S1.1: Ability to evaluate different topologies and processes in electrified vehicle propulsion systems.</p> <p>S1.2: Independent use of acquired knowledge in the analysis, design and</p>
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<p>znanja pri analizi, snovanju in diagnostiki elektrificiranih pogonskih sistemov vozil.</p> <p>S1.3 Sposobnost snovanja učinkovitejših in okolju prijaznejših elektrificiranih pogonskih sistemov vozil z minimalnimi negativnimi vplivi na okolje.</p> <p>S1.4 Sposobnost nadaljnjega, samostojnega študija.</p>	<p>diagnostics of electrified vehicle propulsion systems.</p> <p>S1.3: Ability to design environmentally friendly electrified vehicle propulsion systems with minimized negative environmental impact.</p> <p>S1.4: Ability of independent self-driven education and research.</p>
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#### **Metode poučevanja in učenja:**

P1 Avditorna predavanja z reševanjem izbranih - za področje značilnih - teoretičnih in praktično uporabnih primerov.
P2 Obravnava snovi po urejeni in vnaprej razloženi sistematiki.
P3 Avditorne vaje, kjer se teoretično znanje s predavanj podkrepi z računskimi primeri.
P4 Laboratorijske vaje.
P5 Uporaba študijskega gradiva v obliki (e-verzija predstavitve predavanj).
P8 Izdelava in predstavitev aplikativnih seminarskih nalog
P10 Uporaba anket v realnem času
P14 Virtualni eksperimenti
P15 Uporaba video vsebin kot priprava na predavanja in vaje

#### **Learning and teaching methods:**

P1: Classroom lectures with inclusion of solving selected typical and practical examples.
P2: Presenting of the learning content in an orderly and pre-interpreted systematics
P3: Tutorials where theoretical knowledge of lectures is supported by computational examples.
P4: Laboratory work.
P5: Use of study materials in format (e-version of lecture presentation).
P8: Design and presentation of applied seminar work
P10: Use of real-time surveys
P14: Virtual Experiments
P15: Using video content to prepare for lectures and exercises

#### **Načini ocenjevanja:**

#### **Delež/ Weight**

#### **Assessment:**

Teoretične vsebine (predavanja)	50,00 %	Theory (lectures)
Samostojno delo na vajah	50,00 %	Practical coursework

#### **Ocenjevalna lestvica:**

#### **Grading system:**

5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10
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#### **Reference nosilca/Lecturer's references:**

**Tomaž Kutrašnik:**

1. **KATRAŠNIK, Tomaž**, MOŠKON, Jože, ZELIČ, Klemen, MELE, Igor, RUIZ-ZEPEDA, Francisco, GABERŠČEK, Miran. Entering voltage hysteresis in phase-separating materials : revealing the electrochemical signature of the intraparticle phase-separated state. *Advanced materials*. [Online ed.]. Aug. 2023, vol. 35, iss. 31, [article no.] 2210937, str. 1-18, ilustr. ISSN 1521-4095. [COBISS.SI-ID [151199235](#)]
2. ZELIČ, Klemen, MELE, Igor, BHOWMIK, Arghya, **KATRAŠNIK, Tomaž**. Phase separating electrode materials - chemical inductors?. *Energy storage materials*. Feb. 2023, vol. 56, str. 489-494, ilustr. ISSN 2405-8297. [COBISS.SI-ID [140743427](#)]
3. KRAVOS, Andraž, KREGAR, Ambrož, PENG, Željko, BARBIR, Frano, **KATRAŠNIK, Tomaž**. Real-time capable transient model of liquid water dynamics in proton exchange membrane fuel cells. *Journal of power sources*. Sep. 2022, vol. 541, str. 1-16, ilustr. ISSN 0378-775 [COBISS.SI-ID [110908675](#)]
4. ZELIČ, Klemen, **KATRAŠNIK, Tomaž**. Thermodynamically consistent derivation of chemical potential of a battery solid particle from the regular solution theory applied to LiFePO *Scientific reports*, ISSN 2045-2322, Feb. 2019, vol. 9, f. 1-13. [COBISS.SI-ID [16474651](#)]
5. RAŠIĆ, Davor, **KATRAŠNIK, Tomaž**. Multi-domain and multi-scale model of a fuel cell electric vehicle to predict the effect of the operating conditions and component sizing on fuel cell degradation. *Energy conversion and management*. [Print ed.]. Sep. 2022, vol. 268, str. 1-27, ilustr. ISSN 0196-8904. [COBISS.SI-ID [117952259](#)]

#### Klemen Zelič:

1. **ZELIČ, Klemen**, MELE, Igor, BHOWMIK, Arghya, KATRAŠNIK, Tomaž. Phase separating electrode materials - chemical inductors?. *Energy storage materials*. Feb. 2023, vol. 56, str. 489-494, ilustr. ISSN 2405-8297. <https://www.sciencedirect.com/science/article/pii/S2405829723000090>, <https://repozitorij.uni-lj.si/IzpisGradiva.php?id=144241>, DOI: [10.1016/j.ensm.2023.01.008](https://doi.org/10.1016/j.ensm.2023.01.008). [COBISS.SI-ID [140743427](#)]
2. KATRAŠNIK, Tomaž, MOŠKON, Jože, **ZELIČ, Klemen**, MELE, Igor, RUIZ-ZEPEDA, Francisco, GABERŠČEK, Miran. Entering voltage hysteresis in phase-separating materials : revealing the electrochemical signature of the intraparticle phase-separated state. *Advanced materials*. [Online ed.]. Aug. 2023, vol. 35, iss. 31, [article no.] 2210937, str. 1-18, ilustr. ISSN 1521-4095. <https://onlinelibrary.wiley.com/doi/10.1002/adma.202210937>, <https://repozitorij.uni-lj.si/IzpisGradiva.php?id=148258>, <https://dirros.openscience.si/IzpisGradiva.php?id=16910>, DOI: [10.1002/adma.202210937](https://doi.org/10.1002/adma.202210937). [COBISS.SI-ID [151199235](#)]
3. KREGAR, Ambrož, **ZELIČ, Klemen**, KRAVOS, Andraž, KATRAŠNIK, Tomaž. Educational scale-bridging approach towards modelling of electric potential, electrochemical reactions, and species transport in PEM fuel cell. *Catalysts*. [Online ed.]. Jul. 2023, vol. 13, iss. 7, [article no.] 1131, str. 1-31, ilustr. ISSN 2073-4344. <https://www.mdpi.com/2073-4344/13/7/1131>, <https://repozitorij.uni-lj.si/IzpisGradiva.php?id=148317>, DOI: [10.3390/catal13071131](https://doi.org/10.3390/catal13071131). [COBISS.SI-ID [161059843](#)]
4. KATRAŠNIK, Tomaž, MELE, Igor, **ZELIČ, Klemen**. Multi-scale modelling of the thermal runaway in li-ion batteries. V: RISTIĆ, Alenka (ur.), STRITIĆ, Uroš (ur.). *Enerstock 2021 : 15th International Virtual Conference on Energy Storage* :



*June 9-11, 2021, Ljubljana, Slovenia : book of abstracts.* 15th International Virtual Conference on Energy Storage, June 9-11, 2021, Ljubljana, Slovenia. [Ljubljana]: National Institute of Chemistry, Department of Inorganic Chemistry and Technology; Faculty of Mechanical Engineering, 2021. Str. 271-272. ISBN 978-961-6104-49-4. <https://www.enerstock2021.org/>. [COBISS.SI-ID [82149635](#)]

5. **ZELIČ, Klemen**, KATRAŠNIK, Tomaž, GABERŠČEK, Miran. Derivation of transmission line model from the concentrated solution theory (CST) for porous electrodes. *Journal of the electrochemical society*. [Online ed.]. 2021, vol. 168, no. 7, str. [1-12], ilustr. ISSN 1945-7111.  
<https://iopscience.iop.org/article/10.1149/1945-7111/ac1314>, DOI: [10.1149/1945-7111/ac1314](https://doi.org/10.1149/1945-7111/ac1314). [COBISS.SI-ID [70090755](#)]