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Progress in energy: USA–Canada special issue on energy

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EDITORIAL

Progress in energy: USA–Canada special issue on energy

The current energy landscape mainly encompasses fossil fuels, renewable energy, and nuclear energy.[1–8] CO_2-related concerns have garnered significant research and development focus within the field of fossil fuels.[7,9–11] The development of materials and technologies plays an important role in enhancing energy efficiency and reducing the cost for renewable energy, such as solar energy and bioenergy.[12–29] In the realm of nuclear energy, the fission nuclear power continues to be an essential part of low-carbon electricity generation, but more efforts are needed for the development of advanced reactors, the fabrication of nuclear fuels, the disposal of nuclear wastes, and the restoration of nuclear environment.[30–32] To promote the research and development efforts for energy, ESE is going to publish a series of special issues from different countries. This is the USA–Canada special issue.

The first article in this special issue is a review on rock thermal energy storage (RTES) written by Sasmito and coworkers. Thermal energy storage is essential for the utilization of thermal energy. RTES, as a thermal storage technology, has garnered notable attention owing to its advantages, including large energy storage capacity, a straightforward storage mechanism, and cost-effectiveness. However, it also faces technical challenges, such as the pressure drop across the storage system and the nonoptimal heat transfer between the heat transfer fluid and the storage medium. Addressing these challenges has spurred intensive research and development efforts. This article not only provides a comprehensive review of the advancements in RTES but also discusses nontechnical aspects, including policy and regulations.

Zhang and colleagues conducted a comprehensive review of road transportation, with a particular focus on decarbonization in the second article. Achieving ultralow CO_2 emissions from modern road transportation is imperative. The well-to-wheel greenhouse gas emissions of a propulsion system hinge on two critical factors: the energy efficiency of the system and the carbon intensity of the energy source. This article offers a detailed review of propulsion systems for transportation and explores the decarbonization potential inherent in various propulsion technologies.

The synthetic fuel, capable of meeting all Jet A-1 specifications, has the potential for use as a jet fuel. Fischer–Tropsch-synthesized paraffinic kerosene plus aromatics (FT SPK/A) can, in principle, qualify as Jet A-1. However, significant obstacles remain in the journey toward obtaining global approval for fully formulated synthetic jet fuel. In the third article, Klerk et al. explore various refining pathways that can be utilized to produce FT SPK/A, highlighting the practicality of generating a fully formulated jet fuel through Fischer–Tropsch refining.

CO serves as a crucial feedstock in the chemical industry, contributing to the production of high-value chemicals and clean fuels. This has sparked significant research interest in developing efficient CO conversion processes. Redox potential is a key thermodynamic quantity in these processes, but only standard reduction potentials at 25°C and 1 atm are available. In the last article, we reveal the effects of temperature (0–1000°C), pressure (1–100 atm), and adsorption on the redox potentials of 18 CO conversion reactions to the formation of various compounds. The predicted reduction potentials at different temperatures and pressures can be applied in the design of innovative processes.

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In conclusion, I express my gratitude to all authors, reviewers, and the dedicated Wiley staff for their invaluable contributions to the publication of this special issue.

CONFLICT OF INTEREST STATEMENT

Professor Yun Hang Hu is the Editor-in-Chief of *Energy Science & Engineering*.

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REFERENCES

1. Chu S, Majumdar A. Opportunities and challenges for a sustainable energy future. *Nature*. 2012;488:294-303.
2. Dresselhaus MS, Thomas IL. Alternative energy technologies. *Nature*. 2001;414:332-337.
3. Huber GW, Iborra S, Corma A. Synthesis of transportation fuels from biomass: chemistry, catalysts, and engineering. *Chem Rev*. 2006;106:4044-4098.
4. Su H, Zhang W, Hu YH. Carbonate-superstructured solid fuel cells with hydrocarbon fuels. *Proc Natl Acad Sci USA*. 2022;119:e2208750119.
5. Khodakov AY, Chu W, Fongarland P. Advances in the development of novel cobalt Fischer–Tropsch catalysts for synthesis of long-chain hydrocarbons and clean fuels. *Chem Rev*. 2007;107:1692-1744.
6. Román-Leshkov Y, Barrett CJ, Liu ZY, Dumesic JA. Production of dimethylfuran for liquid fuels from biomass-derived carbohydrates. *Nature*. 2007;447:982-985.
7. Graves C, Ebbesen SD, Mogensen M, Lackner KS. Sustainable hydrocarbon fuels by recycling CO_2 and H_2O with renewable or nuclear energy. *Renew Sustain Energy Rev*. 2011;15:1-23.
8. Zinkle SJ, Was GS. Materials challenges in nuclear energy. *Acta Mater*. 2013;61:735-758.
9. Fang S, Rahaman M, Bharti J, et al. Photocatalytic CO_2 reduction. *Nat Rev Methods Primers*. 2023;3:61.
10. Su H, Hu YH. Thermo-photo catalytic anode process for carbonate-superstructured solid fuel cells. *Proc Natl Acad Sci USA*. 2024;121(2):e2314996121.
11. Hu YH, Ruckenstein E. Comment on "dry reforming of methane by stable Ni–Mo nanocatalysts on single-crystalline MgO". *Science*. 2020;368:eabb5459.
12. Green MA, Ho-Baillie A, Snaith HJ. The emergence of perovskite solar cells. *Nat Photonics*. 2014;8:506-514.
13. Fang S, Lyu X, Tong T, et al. Turning dead leaves into an active multifunctional material as evaporator, photocatalyst, and bioplastic. *Nat Commun*. 2023;14:1203.
14. Li G, Zhu R, Yang Y. Polymer solar cells. *Nat Photonics*. 2012;6:153-161.
15. Wang H, Wei W, Hu YH. NiO as an efficient counter electrode catalyst for dye-sensitized solar cells. *Top Catal*. 2014;57:607-611.
16. Lewis NS, Nocera DG. Powering the planet: chemical challenges in solar energy utilization. *Proc Natl Acad Sci USA*. 2006;103:15729-15735.
17. Wei W, Wang H, Hu YH. Unusual particle-size-induced promoter-to-poison transition of ZrN in counter electrodes for dye-sensitized solar cells. *J Mater Chem A*. 2013;1:14350-14357.
18. Wei W, Chang L, Sun K, et al. The bright future for electrode materials of energy devices: highly conductive porous Na-embedded carbon. *Nano Lett*. 2016;16:8029-8033.
19. Chen X, Liu L, Yu PY, Mao SS. Increasing solar absorption for photocatalysis with black hydrogenated titanium dioxide nanocrystals. *Science*. 2011;331:746-750.
20. Hu YH. A highly efficient photocatalyst—hydrogenated black TiO_2 for the photocatalytic splitting of water. *Angew Chem Int Ed*. 2012;51:12410-12412.
21. Dunn B, Kamath H, Tarascon JM. Electrical energy storage for the grid: a battery of choices. *Science*. 2011;334:928-935.
22. Larcher D, Tarascon JM. Towards greener and more sustainable batteries for electrical energy storage. *Nat Chem*. 2015;7:19-29.
23. Anasori B, Lukatskaya MR, Gogotsi Y. 2D metal carbides and nitrides (MXenes) for energy storage. *Nat Rev Mater*. 2017;2:16098.
24. Slater MD, Kim D, Lee E, Johnson CS. Sodium-ion batteries. *Adv Funct Mater*. 2013;23:947-958.
25. Acerce M, Voiry D, Chhowalla M. Metallic 1T phase MoS_2 nanosheets as supercapacitor electrode materials. *Nat Nanotechnol*. 2015;10:313-318.
26. Chang L, Chen S, Fei Y, Stacchiola DJ, Hu YH. Superstructured $NiMoO_4$@$CoMoO_4$ core-shell nanofibers for supercapacitors with ultrahigh areal capacitance. *Proc Natl Acad Sci USA*. 2023;120:e2219950120.
27. Yu Z, Tetard L, Zhai L, Thomas J. Supercapacitor electrode materials: nanostructures from 0 to 3 dimensions. *Energy Environ Sci*. 2015;8:702-730.
28. Chang L, Hu YH. Breakthroughs in designing commercial-level mass-loading graphene electrodes for electrochemical double-layer capacitors. *Matter*. 2019;1:596-620.
29. Hu YH, Ruckenstein E. Highly effective Li_2O/Li_3N with ultrafast kinetics for H_2 storage. *Ind Eng Chem Res*. 2004;43:2464-2467.
30. Horvath A, Rachlew E. Nuclear power in the 21st century: challenges and possibilities. *Ambio*. 2015;45:38-49.
31. Yun D, Lu C, Zhou Z, et al. Current state and prospect on the development of advanced nuclear fuel system materials: a review. *Mater Rep*. 2021;1:100007.
32. Lou X, Gandy D. Advanced manufacturing for nuclear energy. *JOM*. 2019;71:2834-2836.

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