

The Future of Electric Vehicles: Batteries or Fuel cells



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Résumé/Abstract

The increasing global consumption of fossil fuels, the consequent undesirable rapid growth of CO₂ concentrations and environmental destruction are severe challenges to humankind. The electrification of the transportation sector has gained significant traction in the recent years to deal with these challenges. Two primary forms of vehicle electrification, battery and fuel cell electric vehicles (EVs) have received extensive attention and research. Comparatively speaking, battery seems to have won the first short-term race for green ascendancy, but the case for hydrogen fuel cells refuses to go away, even though its start date is receding into the distance. Some big built-in negatives such as battery production sustainability might undermine battery's long-term dominance, but renewable energy infrastructure still need more time to be sufficiently developed and able to facilitate a holistic hydrogen economy. In great anticipation, we are witnessing the pendulum swing in favor of battery or fuel cells in long-term race.

Herein, we will first present the technical comparison of batteries and fuel cells, then provide a comprehensive evaluation of emerging electric vehicle markets based on various batteries and hydrogen fuel cells, which have the

greatest potential to succeed in commercial applications. Additionally, future prospects about batteries and fuel cells towards long-range, low-cost and high-utilization transportation markets will be proposed, the key points are the next-generation 3D solid-state battery with high safety and better production sustainability, high-efficiency non-precious electrocatalyst with low-cost and long-term stability, and the development of infrastructure for hydrogen transportation and distribution with larger scale and better economic feasibility. Beyond these, we will present our recent progress in advanced batteries and fuel cells by focusing on the aspects of low-cost and high-efficiency electrocatalysts for fuel cells, electrode innovation for batteries, electrolyte design towards high energy density and high safety solid-state batteries.

Bio

Dr. Zhongwei Chen is Canada Research Chair (CRC-Tier 1) Professor in Advanced Materials for Clean Energy at the University of Waterloo, Fellow of the Royal Society of Canada, Fellow of the Canadian Academy of Engineering, Director of Waterloo Center for Electrochemical Energy (WCEE), Associate Editor of ACS Applied Materials & Interfaces (ACS-AMI), and Vice President of International Academy of Electrochemical Energy Science (IAOEES). His research interests are in the development of advanced energy materials and electrodes for fuel cells, metal-air batteries, and lithium-ion batteries. He has published 3 books, 11 book chapters and more than 400 peer reviewed journal articles with over 38,000 citations with a H-index of 101. He is also listed as inventor over 60 US/international patents, with several licensed to companies internationally. He was the recipient of the 2016 E.W.R Steacie Memorial Fellowship, the member of the Royal Society of Canada's College of New Scholars, Artists and Scientists in 2016, the fellow of the Canadian Academy of Engineering in 2017, the Rutherford memorial medal from The Royal Society of Canada in 2017, which followed upon several other prestigious honors, including the Ontario Early Researcher Award, an NSERC Discovery Supplement Award, the Distinguished Performance and Research Award. Dr. Chen was ranked as the Global Highly Cited Researchers by Clarivate Analytics in 2018-2021. He was elected as Fellow of the Royal Society of Canada in 2019.

