

Lithium-Based Batteries, History, Current Status, Challenges and Future Perspectives

Triana Wulandari¹, Derek Fawcett², Subhasish Majumder², and Gerrard Poinern³

¹Murdoch University

²Affiliation not available

³Murdoch University School of Engineering and Information Technology

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Abstract

Currently, the main drivers for developing Li-ion batteries for efficient energy applications include energy density, cost, calendar life, and safety. The high energy/capacity anodes and cathodes needed for these applications is hindered by challenges like: 1) aging and degradation; 2) improved safety; 3) material costs, and 4) recyclability. The present begins by summarising the progress made from early Li-metal anode-based batteries to current commercial Li-ion batteries. Then discusses the recent progress made in studying and developing various types of materials for both anode and cathode electrodes, as well the various types of electrolytes and separator materials developed specifically for Li-ion battery operation. Battery management, handling and safety are also discussed at length. Also, as a consequence of the exponential growth in the production of Li-ion batteries over the last ten years, the review identifies the challenge of dealing with the ever-increasing quantities of spent batteries. The review identifies the economic value of metals like Co and Ni contained within batteries and the extremely large numbers of batteries produced to date and the extremely large numbers that are expected to be manufactured in the next ten years. Thus, highlighting the need to develop effective recycling strategies to reduce the levels of mining for raw materials and prevent harmful products from entering the environment through landfill disposal.

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