New Methodology to Enhance the Cycle Life of Secondary Batteries

IITM Technology Available for Licensing

Problem Statement

- Li-ion or Na-ion batteries suffer from **capacity fading** due to residual Li or Na atoms or sulfur dissolution in Li-S batteries, impacting their **longevity and performance.**
- **Establishing the optimal voltage range** for charging and discharging is critical to mitigate capacity fading and prevent cell degradation.
- Existing methods only offers approximate voltage windows & **lack precision** needed for effective battery management & prolong battery lifespan.
- Some prior arts address **fast charge-discharge rates, low capacity fading, and integrating techniques** like the electrochemical impedance spectroscopy (**EIS**) with cyclic voltammograms (**CV**) for studying capacity fade mechanisms.
- However, the challenge persists in achieving a delicate balance between **maximizing capacity extraction and minimizing capacity fading** & cell degradation. Hence, the instant invention discloses **a New Method to Enhance the Cycle Life of Secondary Batteries.**

Technology Category/ Market

Energy, Energy Storage & Renewable Energy

Industry: Energy Storage Technology

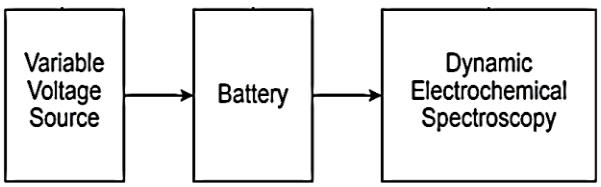
Applications: Lithium-ion batteries, Sodium-ion batteries, Secondary battery systems, Electric Vehicle, Renewable Energy Storage, Battery Management Improvement, Power Backup

Market: The global Secondary Battery market is valued at **$94 M** in **2022,** expected to reach **$216 M** growing at **11% CAGR** from **2023-30**.

Technology

The present technology discloses **a method** for **enhancing secondary batteries life cycle** by determining an optimal charging and discharging voltage range with slight charge transfer resistance by analysis of electrochemical impedance spectra.

FIG. 1



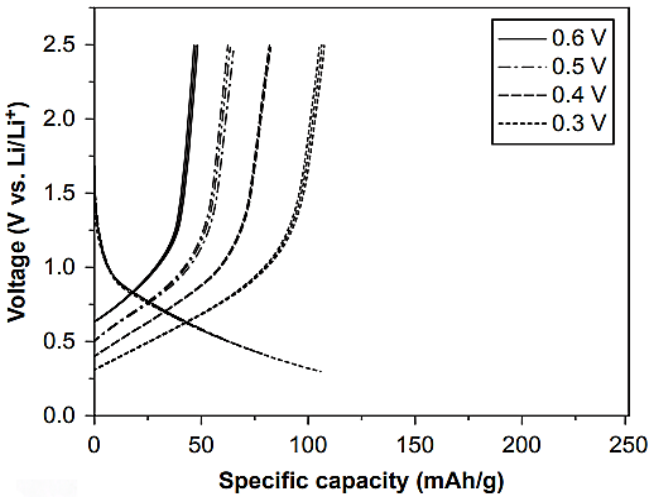


FIG 2A: The galvanostatic charging-discharging of the cell from an upper voltage limit 2.5 V and lower voltage limit 0.6 to 0.3 V.

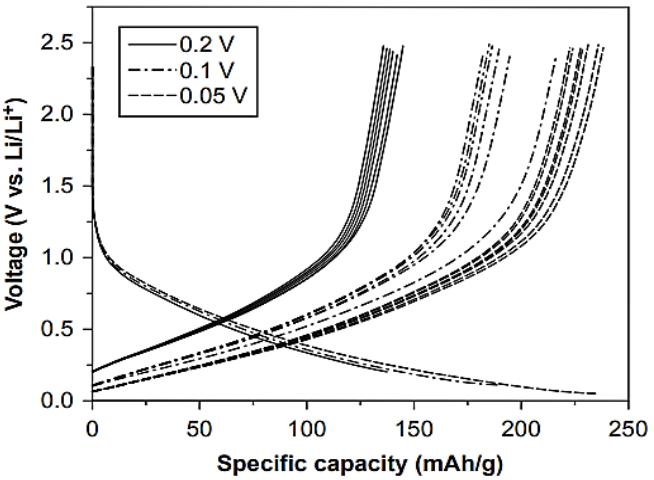


FIG 2B: The galvanostatic charging-discharging of the cell from upper voltage limit 2.5 V and lower voltage limit 0.2 to 0.05 V.

Intellectual Property

IITM IDF No: **1430** | IP No: **494415 (Granted)**

TRL (Technology Readiness Level)

TRL-4: Validated in Laboratory

Research Lab

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Key Features / Value Proposition

User perspective:-

- Prolongs battery life and improves performance by identifying best charging & discharging voltage range, minimizing capacity fading.
- Reduces risk of capacity degradation, ensuring more reliable battery operation over time.
- Offers a straightforward approach for determining optimal voltage range, simplifying battery usage management.

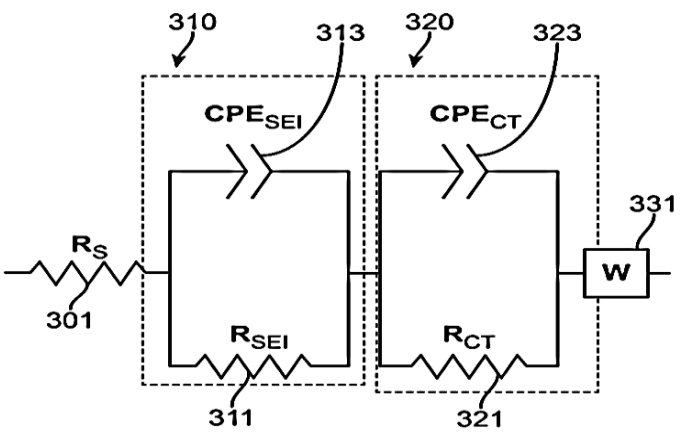
Industrial perspective:-

- Decreases costs related to battery replacement and maintenance, reducing downtime and increasing operational efficiency.
- Provides a competitive edge by offering batteries with extended lifespan, attracting more customers and driving sales.
- Aligns with sustainability goals and regulations, contributing to a greener environment.

Technology perspective:-

- Integrates cutting-edge technology for optimizing battery performance.
- Enables informed decision-making regarding battery charging and discharging.
- Can be adapted for various battery chemistries & applications, offering versatility & scalability.

FIG. 3 shows the equivalent electrical circuit of the electrochemical cell.



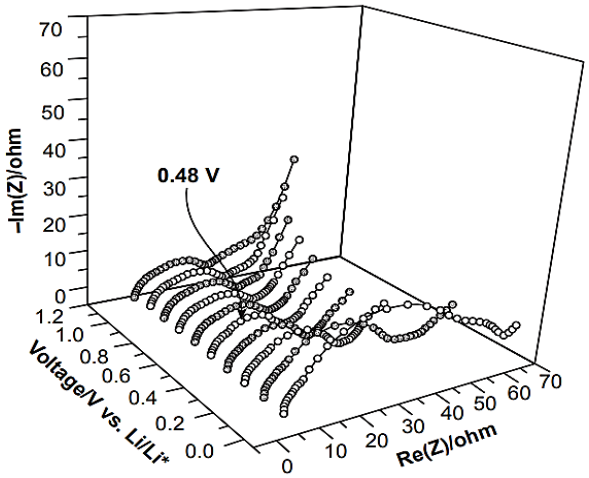
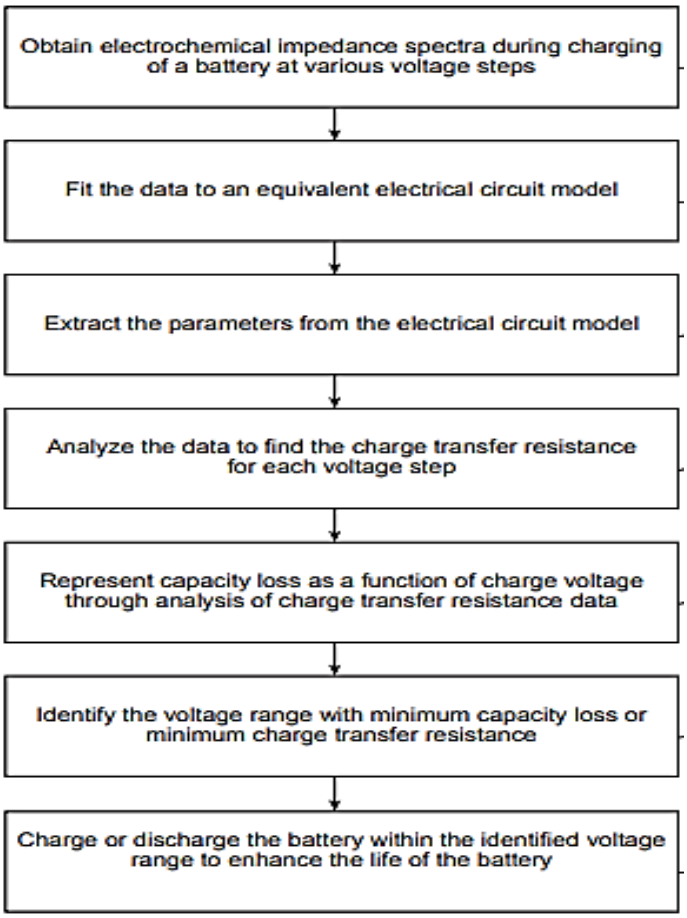


FIG. 4: enlarged view of dynamical electrochemical spectrum of lithium ion half-cell with hard carbon as anode & lithium as counter-reference electrode.

FIG. 5 shows the flowchart of the method for enhancing the life cycle of secondary batteries.



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