

TECH SCAN

LITHIUM-ION BATTERY RECYCLING

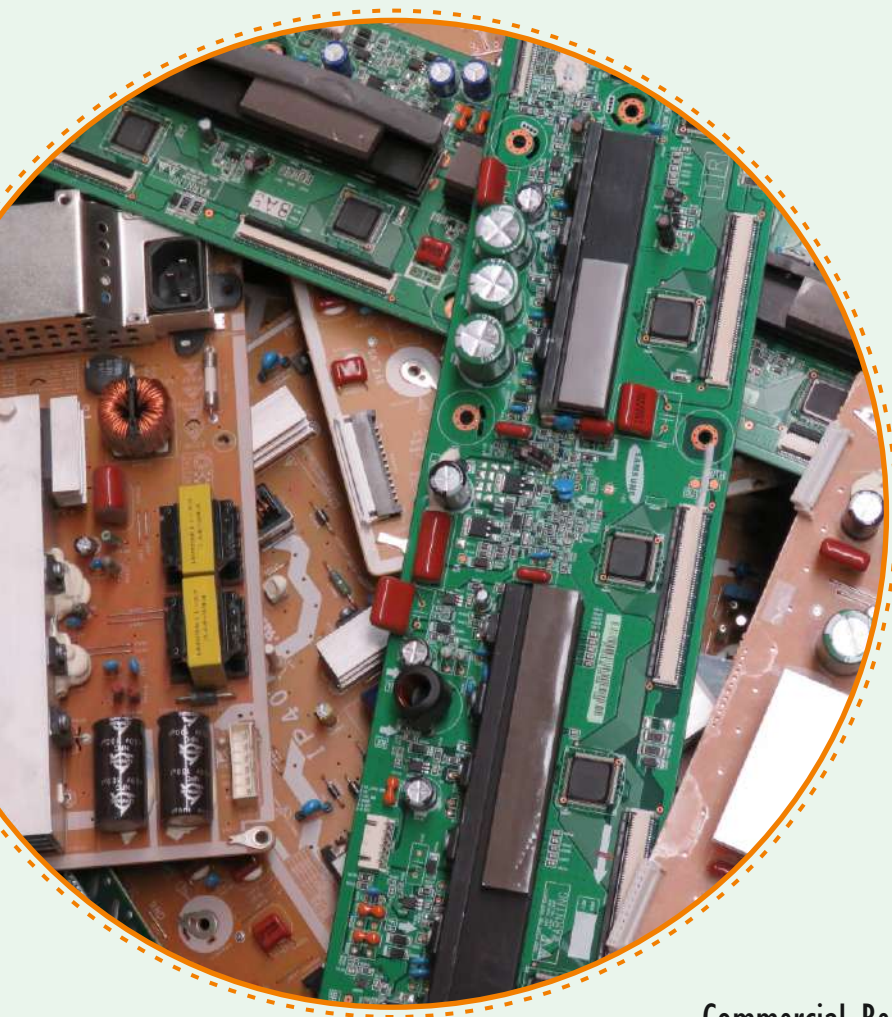


In an era dominated by electronic advancements, the growing popularity of Lithium-ion batteries has given rise to an imperative issue: E-Waste. Considering these batteries' power, modern day electronics and their disposal raise resource and sustainability challenges. New approaches to e-waste recycling, with a particular emphasis on Lithium-ion batteries, have been sparked by the dire need to solve this issue.

Nowadays, patents are being pursued for ground-breaking inventions in a variety of fields, from effective recycling procedures to material recovery and separation techniques to battery disassembly. These developments are essential in lowering the environmental impact of Lithium-ion batteries as they promote the reuse of intact components and strive for the proper disposal of electronic waste. A significant step toward a greener, more resource-conscious technology environment has been carried out with the evolution of e-waste recycling.



INNOVATION TIMELINE



2020:

Direct Extraction, Novel Solvents and Enhancement of Battery Disassembly Efficiency.

2018:

Direct Recycling Technologies

2015:

Closed-loop Recycling Technology

2006:

Commercial Recycling Apparatus and Method for Lithium Batteries

1990s:

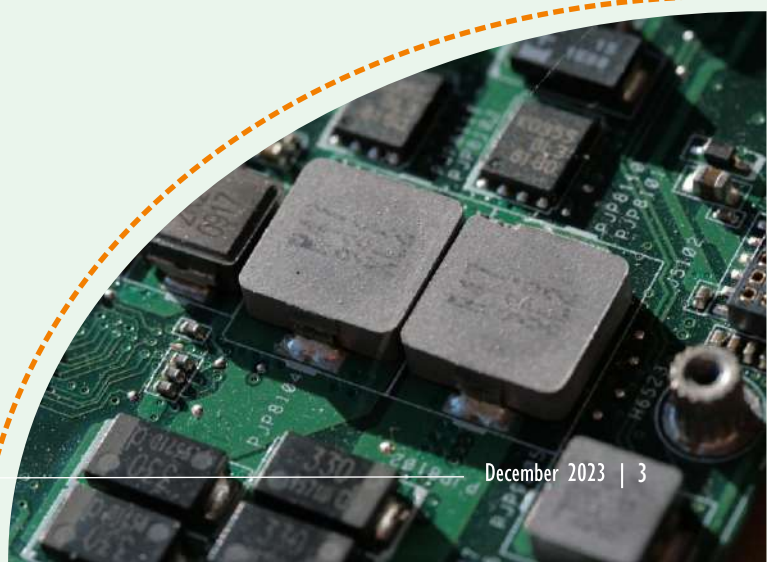
Hydro-metallurgical Process for Lithium Recovery.

2005:

Mixed Recycling of Lithium-based Anode Batteries and Cells.

1980s:

Recycling Lithium Batteries Based on Pyrometallurgical Method.



PATENTABLE COMPONENT

There are a number of elements in recycling e-waste generated by lithium-ion batteries that could potentially qualify for patent protection. Frequently, the following domains are examined for patentability:

CATHODE RECOVERY

- Ambient-Pressure Regeneration
- Aluminium Removal Resin
- Scrap Battery Cathode Material
- Flotation Method

RECYCLING APPARATUS

- Dissolution Device
- Recycling Mechanism
- Cathode to Cathode Recycling
- Closed Loop Recycling

SAFETY FEATURES

- Integral Tubular Battery for Safety Relief System



ENERGY MANAGEMENT

- Smart Charging Algorithm
- High Energy Density

RECOVERY OF METAL

- Pyrometallurgy- Heat Based
- Hydrometallurgy- Liquid Based

ANODE RECOVERY

- Anode Processing
- Acidic Precipitation

SEPERATION TECHNIQUES

- Reactive Phase Separation
- Physical Separation
- Crusher-Classifer

ELECTRODE RECOVERY

- Electrode Dispersion Through Leaching.
- Present Disclosure
- Control Filtrate Flow Rate

Li-BATTERY SYSTEM

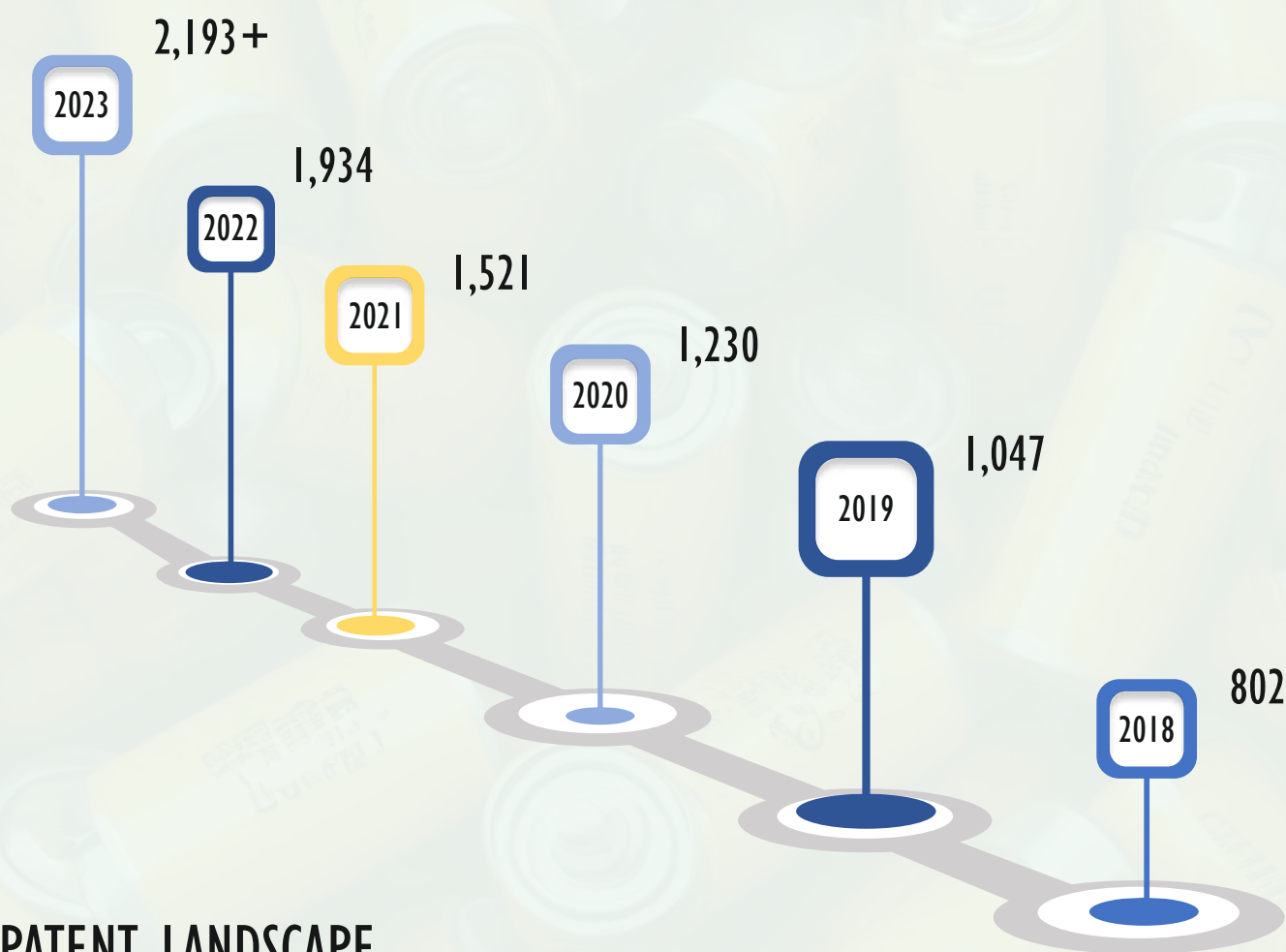
- Battery Dismantling and Disassembling.
- Li-Battery Detaching Device
- Chemical Recovery
- Cell Balancing

GREEN METHOD

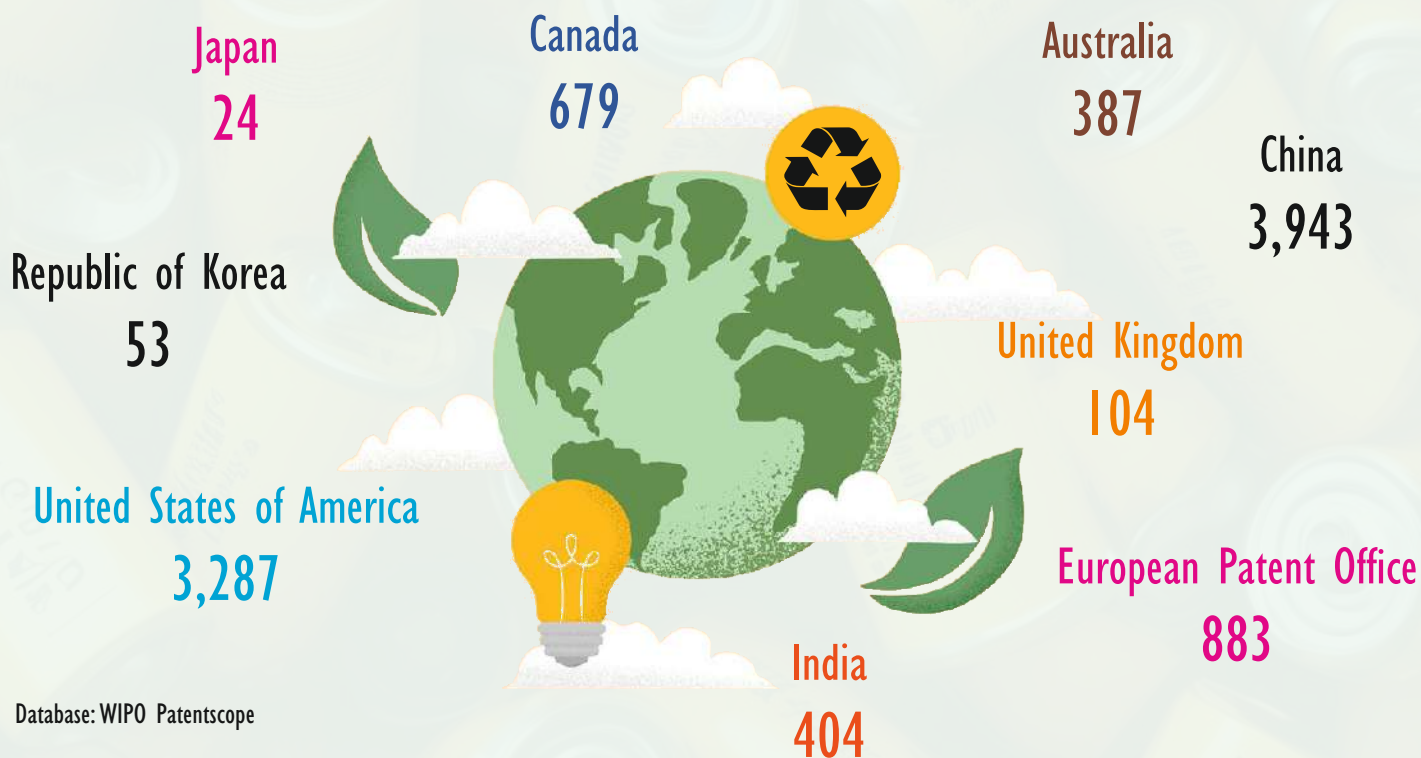
- Green Recycling Method
- Green Reagent / Substance
- Eco-friendly Recycling Device

PATENT STATISTICS

WORLDWIDE PATENT FILING TIME-LINE

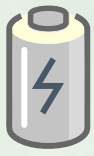


PATENT LANDSCAPE



Database: WIPO Patentscope

TOP APPLICANTS



112
GUANGDONG BRUNP
RECYCLING TECH CO LTD



113
HUNAN BRUNP RECYCLING
TECH CO LTD



86
OSHKOSH CO



91
CENTRAL SOUTH
UNIVERSITY



48
CARBON TECH
HOLDINGS LLC



64
HUNAN BRUNP EV
RECYCLING CO LTD



63
CONTEMPORARY AMPEREX
TECH CO LIMITED



57
TOYOTA JIDOSHA
KABUSHIKI KAISHA



52
LG ENERGY
SOLUTION LTD



18
ATTERO RECYCLING PVT LTD



56
INSTITUTE OF PROCESS ENGINEERING
CHINESE ACADEMY OF SCIENCES

Database: Questel Orbit

WHITE SPACES

In the rapidly evolving field of lithium-ion battery recycling, there are several whitespace areas where innovation and development opportunities exist. These include:

- Magnetically Separating Positive and Negative Electrode Powder from Lithium Battery
- Device for Disposal of Lithium Batteries
- Use of Fluidized Bed Reactor for Recovery of Active Metal
- Use of Gemini Surfactant
- Optimization of Composition and Properties of the Black Mass



- Bio-hydrometallurgy for Metal Recovery
- Direct Recycling without Intermediate Steps
- Automated Lithium Unpacking Machine
- Automated Dismantling Processes
- Viscosity Detection System for Lithium Battery Slurry

- Cathode-Free Battery Preparation
- Developing Methods to Minimize or Eliminate the Generation of Waste during the Recycling Process
- Energy-efficient Recycling Process
- Regeneration Method of Ternary Cathode Material
- Real Time Monitoring



- Dry Ice Lithium Battery Crushing
- Microwave-enhanced Battery Recovery
- Cathode-Free Battery Preparation
- Selective Extraction of Metals

REMARKABLE INNOVATIONS

Patent Application	Priority Date	Title	Assignee
W02017006209	Jul 6, 2015	A Method of Recovering Metals from Spent Li-ion Batteries	Attero Recycling Pvt Ltd
W02018047147	Sep 12, 2016	Process for Recovering Pure Cobalt and Nickel From Spent Lithium Batteries	Attero Recycling Pvt Ltd
EP3563446	Feb 19, 2018	Recycling Method for Lithium ion Batteries	Weck Poller Holding Gmbh Wks Technik Gmbh
US20220140412	Mar 4, 2019	System for and Method of Processing Waste Lithium-ion Battery	Kawasaki Heavy Ind Ltd
US20230352756	Nov 26,2020	Methods for Impurity Removal and Treatment in Recycling Process of Scrap Positive Electrode Materials of Lithium Batteries	Sichuan Energy Int Res Inst Tsinghua Univ
US20230335818	Sep 30, 2021	Method for Separating and Recovering Valuable Metals from Waste Ternary Lithium Batteries	Hunan Brunp Recycling Technology Co. Ltd.
W02023154741	Feb 8, 2022	Reactive Phase Separation of Black Mass from Lithium-ion Battery Recycling and Methods	Comstock Ip Holdings LLC
US20190123403	Apr 8, 2022	Recycling Apparatus for Waste Lithium Battery	Niocyte Teknoloji Tic San a S
W02023194506	Apr 8, 2022	Lithium-ion Battery Recycling Method	Niocyte Teknoloji Tic San a S
W02023205852	Apr 28,2022	Processes and Apparatus for Recycling Battery Waste Materials	Gelion Tech Pty Ltd
W02023214366	May 5, 2022	A Method of Removing and Safe Disposal of Electrolyte from Spent Lithium-ion Batteries	Attero Recycling Pvt Ltd
W02023224907	May 16, 2022	Method and System for Recovery of Electrode Metals from Spent Lithium-ion Batteries	Agr Lithium INC
W02021177733	Sep 22, 2022	Method for Recovering Active Metal of Lithium Secondary Battery	Sk Innovation Co., Ltd.
CN116404287	Mar 31, 2023	Lithium Battery Recycling and Disassembling System	Guangdong Brunp Recycling Technology Co. Ltd

If you would like to learn more about any of these areas or have specific questions, we're here to provide further information and insights. Our team is dedicated to driving progress and staying at the forefront of Lithium-ion Battery Recycling.

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