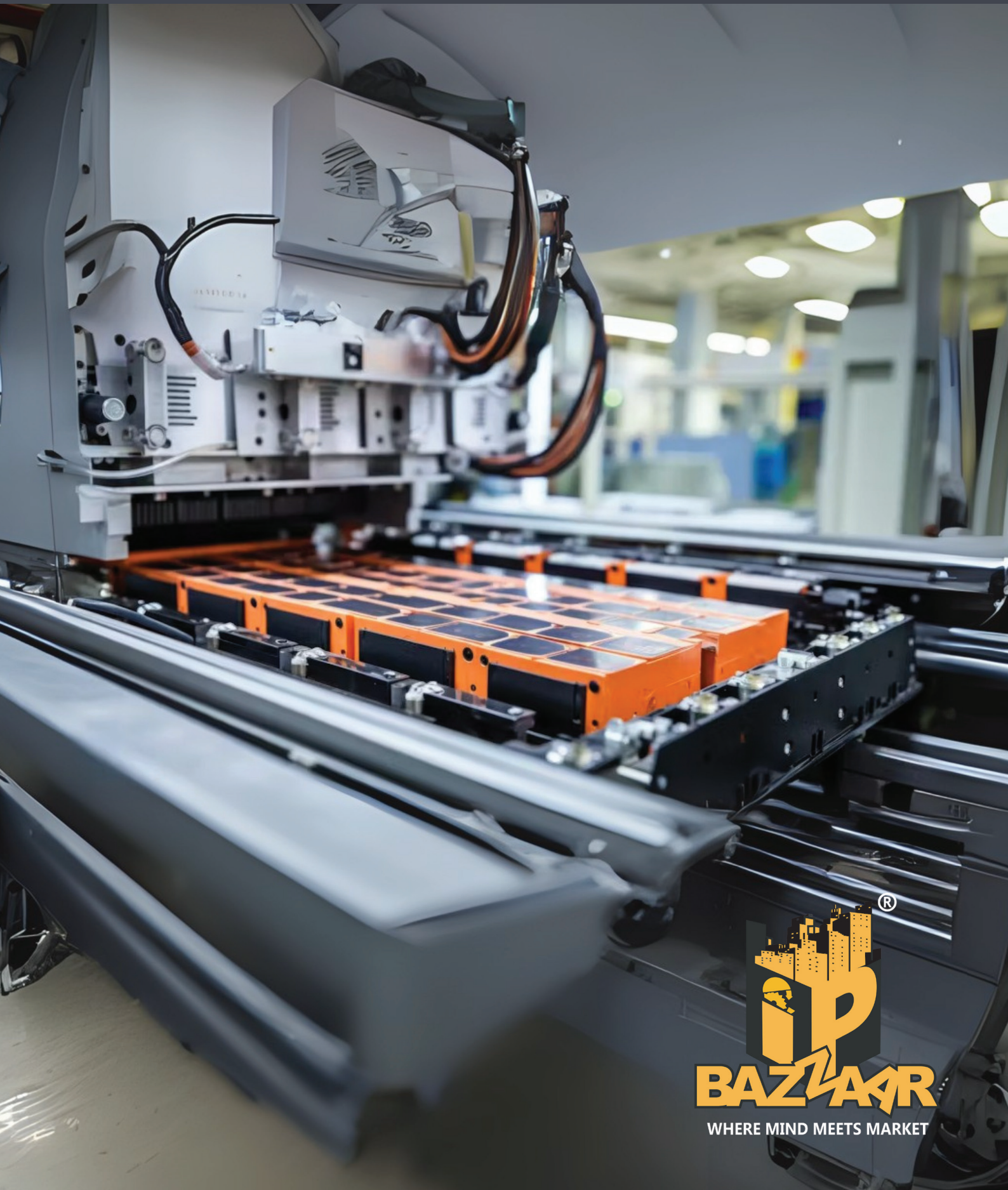


TECH SCAN

LITHIUM-ION BATTERIES FOR ELECTRIC VEHICLES



Lithium-ion batteries have emerged as the primary energy storage solution for electric vehicles (EVs), owing to their high energy density, long life cycle, and light weight property. As the global shift toward sustainable transportation accelerates, the demand for efficient and reliable battery systems continues to grow, positioning lithium-ion technology at the core of EV innovation.

A typical lithium-ion battery consists of four main components: a cathode, an anode, an electrolyte, and a separator. These components work together to enable the flow of lithium ions between electrodes during charging and discharging cycles. Recent advancements in this field include the development of solid-state batteries, silicon-based anodes, lithium iron phosphate (LFP) cathodes, and

improved battery management systems (BMS). These innovations aim to enhance battery composition, energy efficiency, thermal control, and system integration improving safety and lowering production costs.

The lithium-ion battery sector has witnessed a significant surge in patent filings over the past decade, driven by the growing demand for electric vehicles and continuous technological advancements. A notable rise in contributions from universities, research institutions, and start-ups reflects the expanding and diversified innovation ecosystem. These trends emphasize the strategic role of patents in safeguarding innovations, enabling technology transfer, and strengthening global R&D collaboration.



INNOVATION TIMELINE

1972

Stanley Whittingham develops the first rechargeable lithium battery using titanium disulfide as anode

1983

John B. Goodenough discovers lithium cobalt oxide as cathode material

1985

Akira Yoshino develops the first commercially viable lithium-ion battery

1991

Sony commercialised its first lithium-ion battery product

1996

A lithium-ion battery with a lithium iron phosphate cathode develops

1998

The first Electric Vehicle to utilize Lithium-ion Battery Technology launches

2002

Silicon-carbon composite anodes enhance the performance of lithium-ion batteries

2006

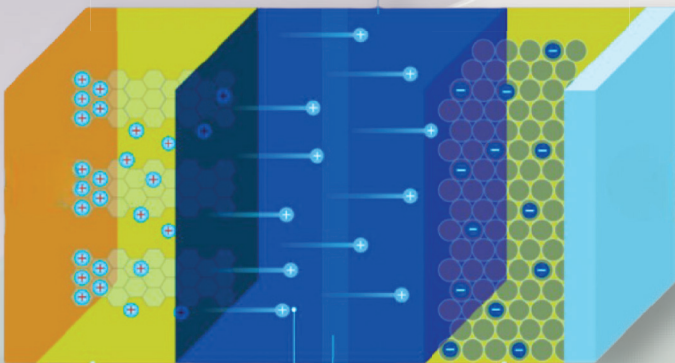
Nano phosphate lithium-ion battery technology develops

2017

Introduction of Solid-State Battery Prototypes

2023

Dry electrode coating of Lithium-ion Battery develops



The 2019 Nobel Prize in Chemistry is awarded to Goodenough, Whittingham, and Yoshino for their contributions to the development of the lithium-ion battery.



Several elements in lithium-ion batteries could potentially qualify for patent protection. Typically, the following domains are examined for patentability:

Cathode Active Materials

- Lithium Cobalt Oxide (LiCoO_2)
- Lithium Nickel Manganese Cobalt Oxide (NMC)
- Lithium Iron Phosphate (LFP)

Electrolyte Systems

- Liquid Electrolytes
- Solid-State Electrolytes
- Sulfide-based
- Polymer-based

Coated Separators

- Ceramic-coated separators
- PVDF-coated separators

Battery Cell Design & Packaging

- Pouch Cell Laminate Structures
- Multi-layer films with aluminum foil and polymer coatings
- Cylindrical or Prismatic Cell Configurations
- Spiral-wound or stacked electrode assemblies

Manufacturing Methods

- Slurry Preparation and Coating
- Techniques for uniform dispersion of active materials
- Dry electrode coating methods for solvent-free processing
- Methods to reduce gas generation and improve cycle life

Anode Active Materials

- Graphite (natural or synthetic)
- Lithium Titanate ($\text{Li}_4\text{Ti}_5\text{O}_{12}$)
- Silicon-based composites

Separator Technologies

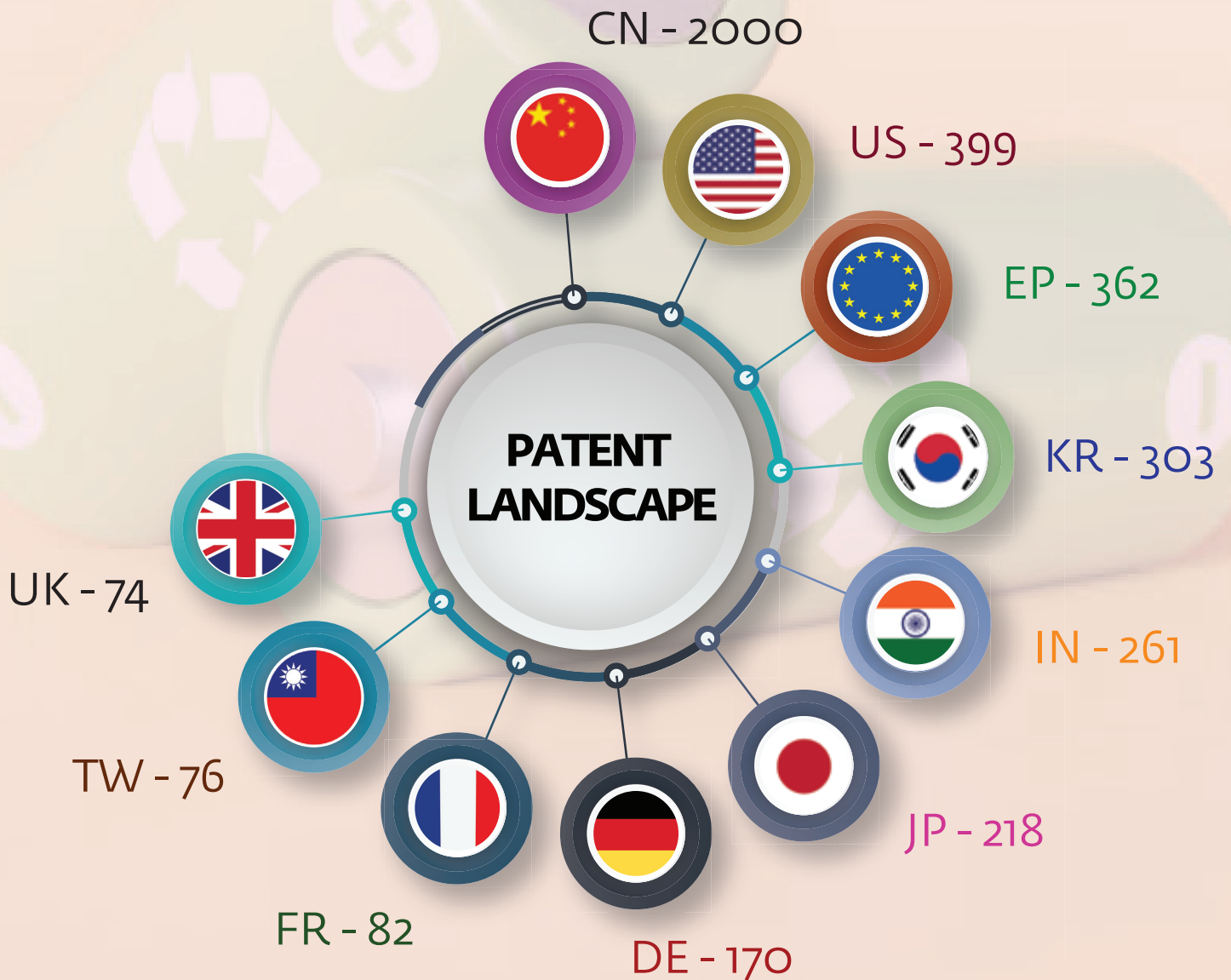
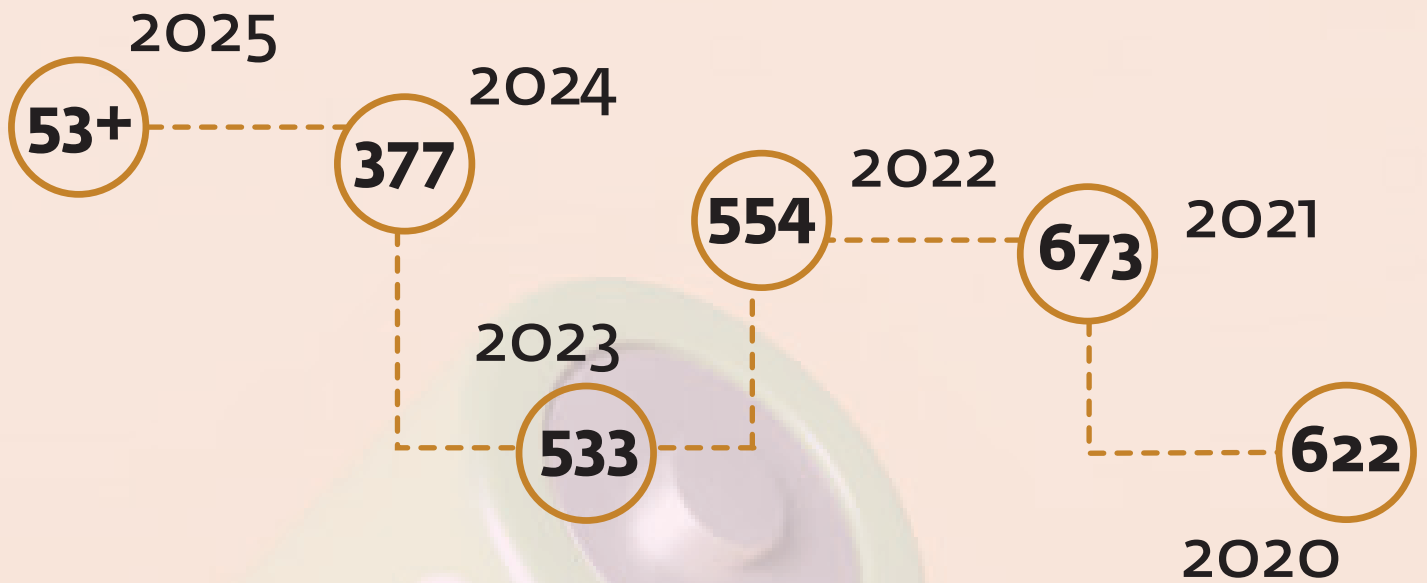
- Microporous Polyolefin Films
- Polyethylene membranes
- Polypropylene membranes

Current Collectors

- Aluminum Foil for Cathode
- Copper Foil for Anode



PATENT STATISTICS



Database: Questel Orbit
Data Range: 01/01/2020 - 07/07/2025

TOP APPLICANTS



Database: Questel Orbit

Data Range: 01/01/2020 - 07/07/2025

NOTABLE INNOVATIONS

Patent Application	Priority date	Title	Assignee
US4009052	25.01.1978	Chalcogenide Battery	ExxonMobil Research & Engineering
US4302518	05.04.1979	Electrochemical Cell with New Fast Ion Conductors	Goodenough John B. ; Mizushima Koichi
US4585718	06.03.1984	Lithium-Manganese Dioxide Cell	SONY
JP1994275321	18.03.1993	Lithium Secondary Battery	Toshiba Corp
US6004688	16.07.1997	Solid Oxide Fuel Cell and Doped Perovskite Lanthanum Gallate Electrolyte Therefor	University of Texas
US20040131937	06.01.2003	Lithium Ion Battery comprising Nanomaterials	Hon Hai Precision Ind. Co.
EP2039560	19.09.2008	Charging Device for Electric Vehicle	Fuji Heavy Ind Ltd
WO2010117219	08.04.2009	Lithium-sulfur Battery	IUCF-HYU (Industry University Cooperation Foundation Hanyang University)
CN102683649	11.03.2011	Method for Preparing Lithium Ion Battery Carbon Silicon Anode Material	Tongji University
CN103384012	06.11.2013	Current Collector Structure of Positive Electrode of Lithium Ion Battery and Battery Including Structure	Amperex Technology Ltd.
US20230330460	03.04.2023	Systems for Fire Suppression with Encapsulated Suppressant Agent	Tyco Fire Products LP

WHITESPACES

In the rapidly evolving field of Lithium-ion Battery, there are various areas with potential for innovation and development opportunities. These encompass:

Focus on
Nanotechnology
in Materials

Combining only
Inorganic Materials
forms the Electrolyte

Using Polymeric Materials,
such as Gel-Type or Solid-Type

Using Non-Aqueous
Electrolyte for Accumulators

Replacing the Electrolyte
with exclusively Organic
Materials

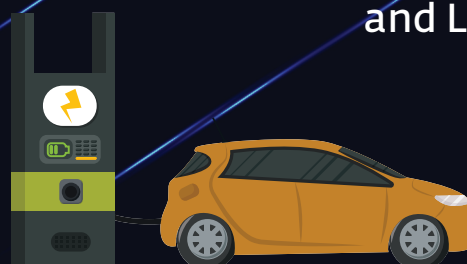
Coating Active Material on
Electrode Collectors

Selecting Carbon or
Graphite for Active
Masses

Electrodes without oxides or
hydroxides (like sulfides,
selenides and others)

Combining Nuclear
and Lithium Technologies

Selecting Lithium
Alloy as Carriers
or Collectors



Database: Questel Orbit

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 Batteries for Electric Vehicles.

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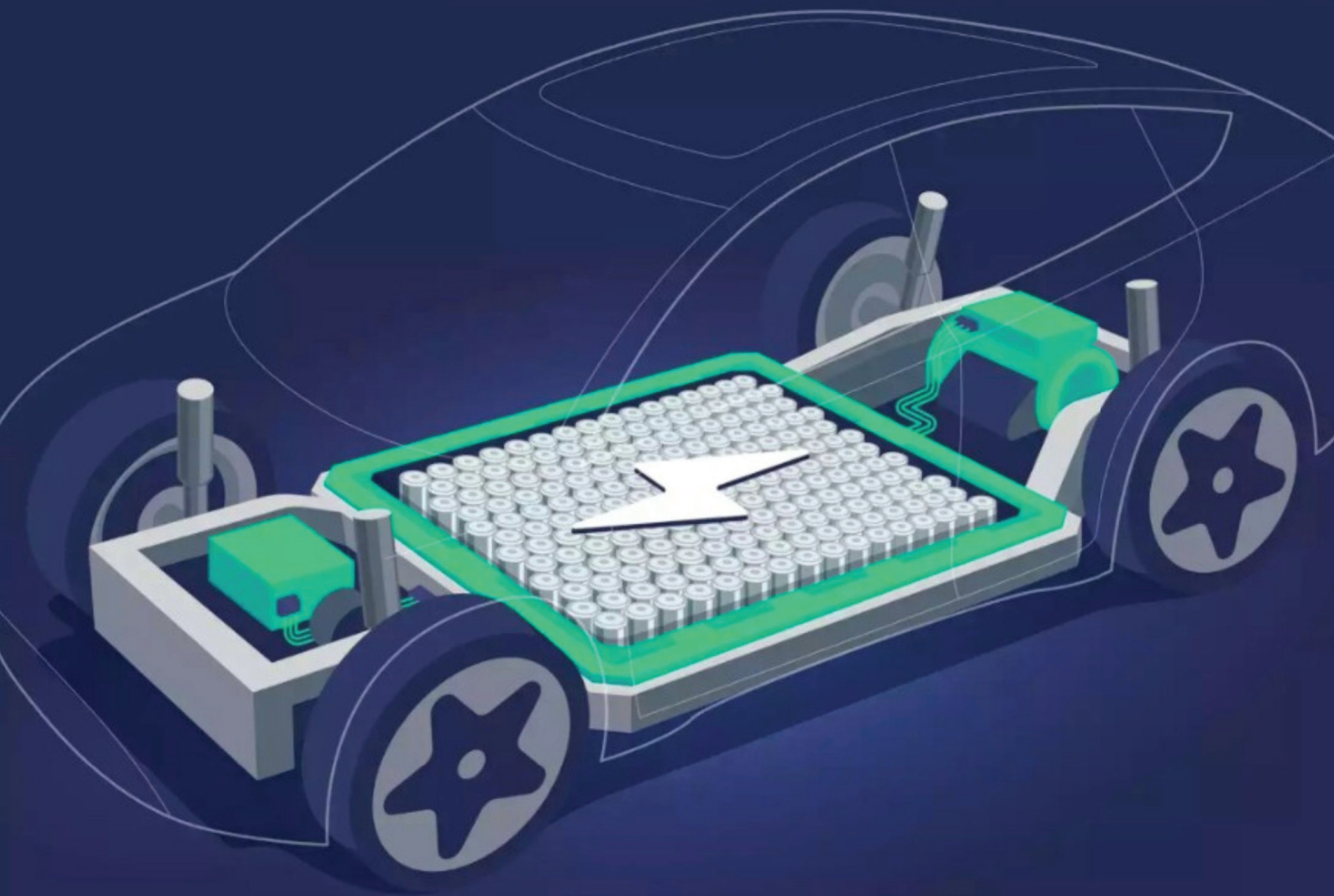


Lalit Ambastha

Co-Founder, IP Bazaar

Mob: +91-9811367838

Email : tech@ipbazaar.com



IP BAZZAAR TECHNOLOGY CONSULTANTS PVT. LTD

716, Seventh Floor, DLF Prime Towers, Okhla Phase I, New Delhi-110020, India

www.ipbazaar.com