METHOD FOR SYNTHESIS OF ORDERED MESOPOROUS $LiFePO_4$/N-DOPED CARBON (LIP/MNC-31) COMPOSITE

IITM Technology Available for Licensing

PROBLEM STATEMENT

- Mesoporous LiFePO4/C composite is used as **cathode materials in Li-ion batteries** due to its high surface area and superior textural properties.
- Common carbon sources include **citric acid, glucose, and sucrose** for **uniform coating**.
- A one-pot synthesis of ordered mesoporous LIP/MNC-31 composite was achieved using a **nanocasting approach** and high-temperature calcination in an inert atmosphere, resulting in a **metal-free high-surface-area nitrogenous** composite.
- A liquid co-precipitation method for producing LiFePO4/CRF nano composite as a **positive electrode material, overcoming cumbersome methods** and long experimental duration.
- An **improved method** for synthesizing ordered mesoporous LiFePO4/N-doped Carbon (LIP/MNC-31) composite using a nano-casting technique is **needed,** as well as for synthesis as superior cathode material for **high-performance Li-ion batteries**.

TECHNOLOGY CATEGORY/ MARKET

Technology: Mesoporous LiFePO4/N-doped Carbon (LIP/MNC-31) composite.
Category: Advance Material & Manufacturing/Energy
Industry: Chemical Industry, Materials Science
Application: Energy Storage/Li-ion batteries.
Market: The global market size of mesoporous silica Market size was valued at **US$ 194.8 Million in 2023** and is expected to reach **US$ 388.7 Million by 2031,** growing at a compound annual growth rate **(CAGR) of 10.4% from 2024 to 2031.**

INTELLECTUAL PROPERTY

IITM IDF Ref.1701 Patent No: IN 529192

TRL (Technology Readiness Level)

TRL-4, Experimentally validated in Lab;

Research Lab

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TECHNOLOGY

Method

Synthesis of ordered mesoporous LiFePO4/N-doped Carbon (LIP/MNC-31) composite as superior cathode material for high performance Li-ion batteries

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Adding **5g** of **PVP (polyvinylpyrollidone)** in **20 mL** of **dichloromethane** and vigorously **stirred** for **1 h at 303 K;**

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Adding and **stirring SBA-15 for 6 h** at room temperature and placing the mixture in a **drying oven** at **343 K for 6 h**;

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Carbonization of mixture by pyrolysis at preferred temperatures in the range **of 873 - 1273 K (preferably at 1173 K) for 6 h** with a heating rate of **5.0°C min^{-1}**

↓

under **inert gas flow** wherein the resulting carbon/silica composite can be dissolved in **15 wt% HF at room temperature, in order to remove the silica.**

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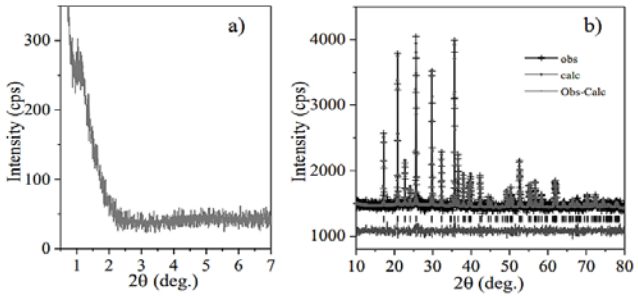

Fig 1 illustrates a graphical representation demonstrating the XRD patterns and Rietveld refinement data of ordered mesoporous LIP/MNC-31 composite

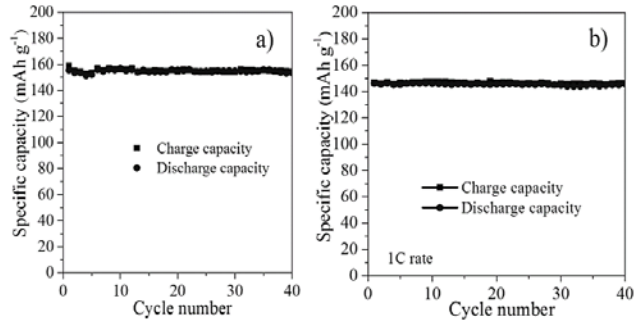

Fig 4 illustrates a graphical representation of cycling performance of the mesoporous LIP/MNC-31 meso-composite at the charge/discharge rate of: a) 0.1 C and b) 1 C,

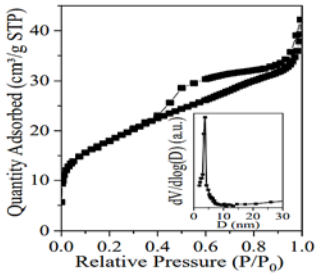

Fig 2 illustrates a graphical representation illustrating **N2 sorption isotherms** of mesoporous LIP/MNC-31 composite (the inset shows the corresponding PSD)

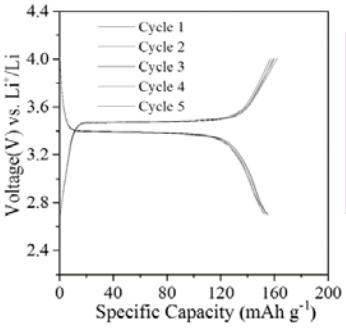

Fig 3 illustrates a graphical representation of Galvanostatic charge discharge profiles recorded at current rate of 0.1 C

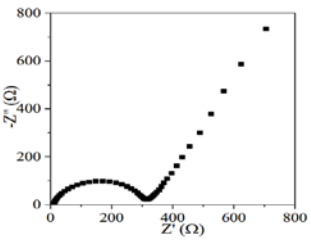

Fig 5 illustrates a graphical representation of electrochemical impedance spectra of LIP/MNC-31 electrode

Key Features / Value Proposition

- Good **reversibility** and enhanced **specific capacity**.
- Novel ordered nitrogenous mesoporous carbon **(MNC-31) as hard template**.
- **Lithium** foil used as **both the reference and counter electrode**.
- superior cathode material for **high-performance Li-ion batteries**.

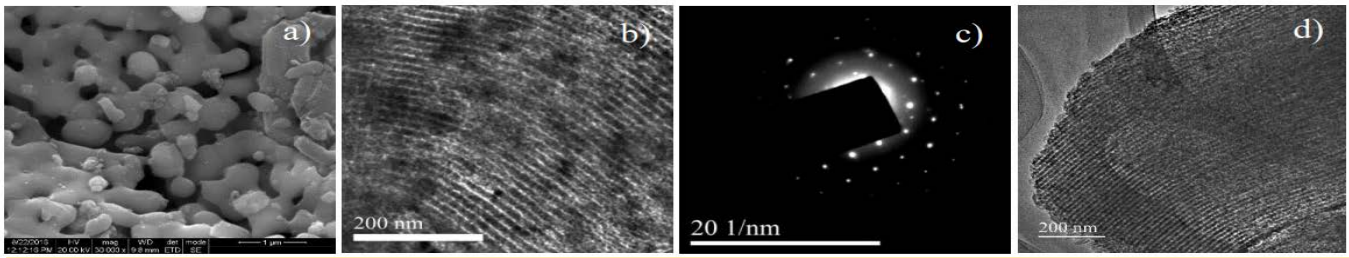

Fig 6 illustrates a graphical representation of **SEM**
- **(a) TEM**
- **(b) Images and SAED pattern**
- **(c) Mesoporous LIP/MNC-31 composite;TEM**
- **(d) Image of NMC-31**

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