



Industrial Consultancy & Sponsored Research (IC&SR)

HIGH PERFORMANCE ELECTRODE ACTIVE MATERIAL AND A METHOD FOR PREPARATION THEREOF

IITM Technology Available for Licensing

PROBLEM STATEMENT

- **Hydroquinone** is used in **photographic development, polymerization inhibitors, and skin care products.**
- **High demand** for catalysts for selective oxidative dehydrogenation leads to higher conversion rates.
- **Iron phosphate (FePO₄)** is a **popular catalyst** for selective oxidative dehydrogenation and partial oxidation reactions.
- However, attempts to **synthesize ordered mesoporous iron phosphate** using cationic and anionic surfactants have been limited.
- **Hydroquinone production** involves selective hydroxylation of **phenol using H₂O₂.**
- The **need for a catalyst with improved phenol conversion**, hydroquinone production method, and enhanced selectivity is still significant.

TECHNOLOGY CATEGORY / MARKET

Technology: Production of Hydroquinone by Oxidation of Phenol

Category: Chemistry & Chemical Analysis

Industry: Catalysts, Advanced material

Application: Photographic developer

Market: The global market size is **expected to reach US\$26.13 billion in 2024** and the **latest industry analysis forecasts** the market to expand at **4.8% CAGR** and reach **US\$ 41.77 billion by 2034 end**

INTELLECTUAL PROPERTY

IITM IDF Ref. 1673

Patent No: IN 541895

TRL (Technology Readiness Level)

TRL- 4, Experimentally validated in Lab;

Research Lab

Prof. Selvam P

Dept. of Chemistry

TECHNOLOGY

Method for the preparation of MIP for electrode.

1

• Mix a **first solution** containing **iron (III) nitrate nonahydrate** and a **second solution** containing **anhydrous diammonium hydrogen phosphate** to obtain a **first precipitate**

2

• Suspend the **precipitate in water** and **add HF** to form a **third solution**

3

• Mix **third solution** with a predetermined amount of **1-hexadecyl-3-methylimidazolium chloride** or **cetyltrimethylammonium bromide in water** to obtain **fourth solution**

4

• Stir the **obtained fourth solution** and **heat it** at a temperature of **50-70°C** for a predetermined time period

5

• Add **tetramethyl ammonium hydroxide (TMAOH)** solution to the **fourth solution** to obtain a **second precipitate**

6

• **Remove surfactants** and **purify** the **second precipitate**

7

• **Calcine the purified second precipitate** at a temperature in the range of **250-300°C** to obtain **mesoporous FePO₄**

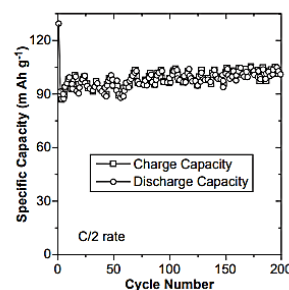
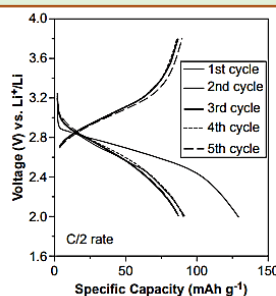
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• Add **mesoporous FePO₄**, **acetylene black** and **poly (vinylidene difluoride) (PVDF)** to a solvent to obtain a **slurry**

9

• **Coat the slurry** on a **conductive substrate** to obtain an **electrode**

Galvanostatic charge-discharge profiles recorded at 0.5c cycling performance of the mesoporous mip-41(ii) cell



CONTACT US

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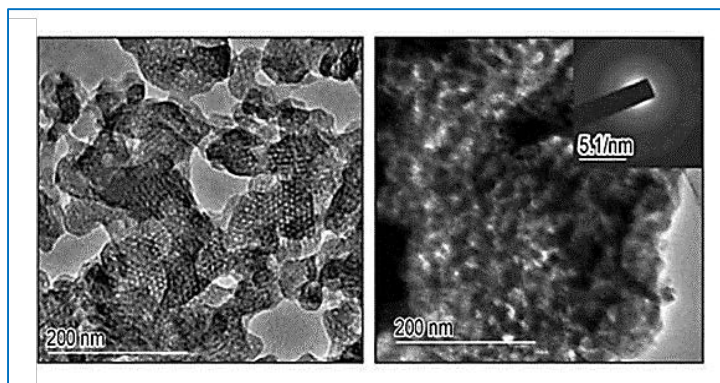
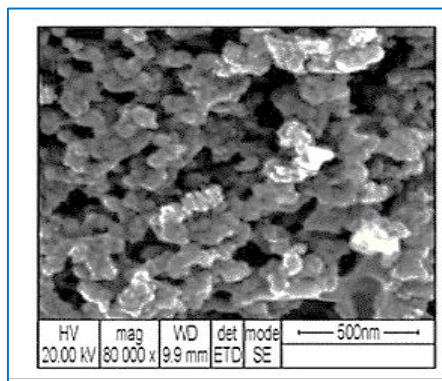
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SEM image

MIP-4I(IL)

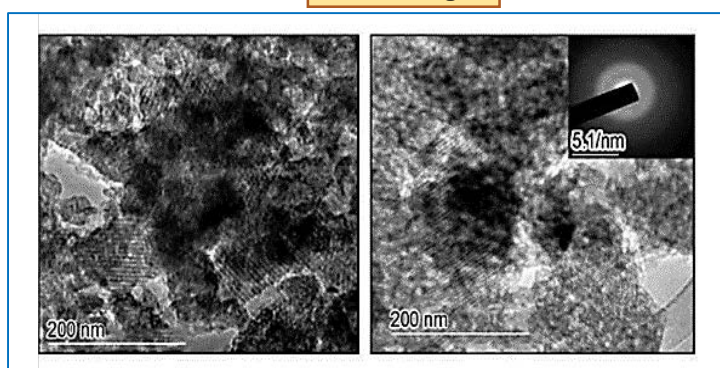
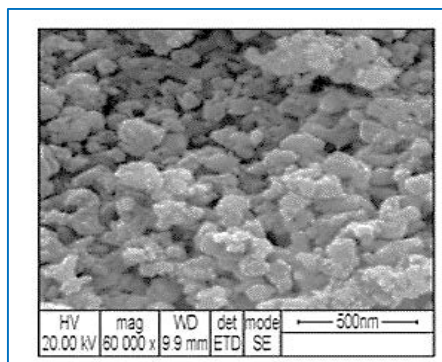
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SEM image

MIP-4I(CS)

TEM image



Key Features / Value Proposition

- **Electrode for Electrochemical Applications**
 - Composed of mesoporous iron phosphate (MIP) active material.
 - MIP has pore volume (0.30-0.48) cm³g⁻¹.
 - Surface area (110-200 m²g⁻¹) or pore size distribution (PSD) 2.9-3.6 nm.
- **MIP Active Material Electrode**
 - Pore volume: 0.30-0.39 cm³g⁻¹.
 - Surface area: 110-130 m²g⁻¹.
 - Pore size distribution: 2.9-3.2 nm.
- **MIP Active Material Electrode Specifications**
 - Pore volume: 0.40 to 0.48 cm³g⁻¹.
 - Surface area: 180 to 200 m² g⁻¹.
 - Pore size distribution (PSD): 3.3 to 3.6 nm.
 - Electrode: A cathode with a first discharge capacity of 160 to 176 mAh g⁻¹.
 - Reversible capacity: At least 154 mAh g⁻¹ at 40 cycles at C/10 (0.1C) cycles.
- **Columbic efficiency: Up to 100%.**
- **Fabricating an Electrode Method**
 - Add mesoporous iron phosphate (MIP), acetylene black, and poly(vinylidene difluoride) (PVDF) to a solvent.
 - MIP ranges from 60 to 80 wt%, acetylene black from 10 to 30 wt%, and PVDF from 5 to 15 wt%.
 - MIP has pore volume (0.30 to 0.48 cm³g⁻¹), surface area (110 to 200 m²g⁻¹), and pore size distribution (PSD) 2.9 to 3.6 nm.
 - Coat the slurry on a conductive substrate with a specified loading of MIP active material (1.5 to 2.5 mgcm⁻²).

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