IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

HYDROQUINONE SELECTIVE CATALYST 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 ($FeP0_4$)** 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 H_2O_2.**
- 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.1579 ,
Patent No: IN 341547

TRL (Technology Readiness Level)

TRL - 3, Experimental Proof of concept

Research Lab

Prof. Selvam P
Dept. of Chemistry

TECHNOLOGY

Method for preparing mesoporous $FeP0_4$

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 $FeP0_4$**

Method of preparing hydroquinone from oxidation of phenol

1. **Add phenol** to a **suspension of $FeP0_4$** in **catalyst in glacial acetic acid**
2. **Heat** the reaction **mixture**
3. **Add oxidant** to the reaction mixture to **initiate oxidation** of phenol on the surface of **mesoporous $FeP0_4$**
4. **Allow** the **reaction to continue** for a predetermined **time period** thereby **forming hydroquinone** in the reaction mixture

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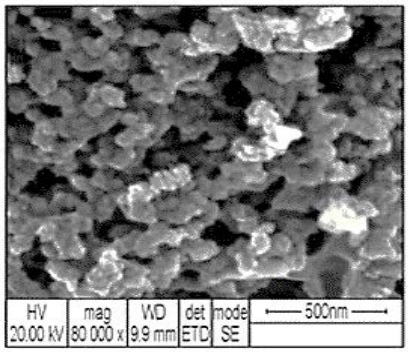
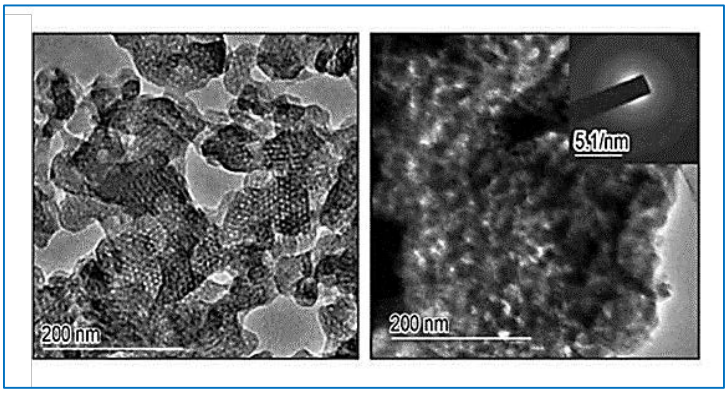
MIP-4I(IL)

TEM image



SEM image



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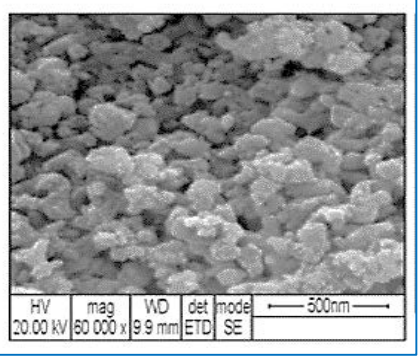
TEM image



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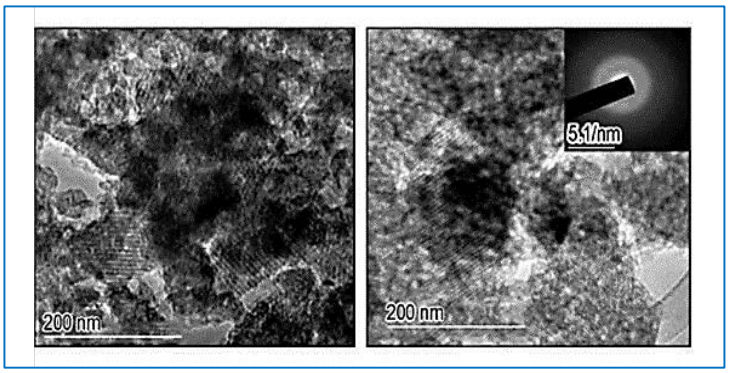
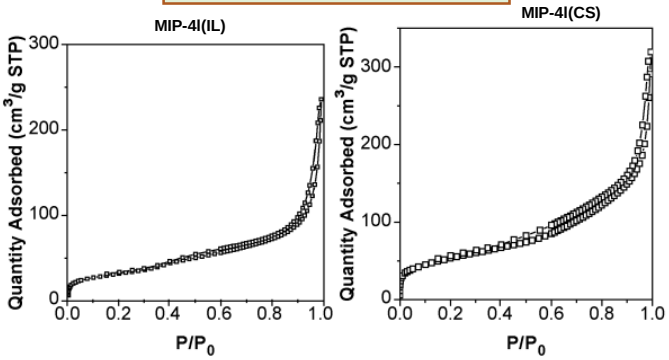


Key Features / Value Proposition

- Mesoporous Iron Phosphate (Mip) Catalyst for Parahydroxylation of Phenol
- **Pore Volume**
  - Range of **0.30-0.48 cm^3 g^{-1},**
- **Surface Area**
  - Range of **110-130 m^2g^{-1}**,
- **Pore Size Distribution (PSD)**
  - Range of **2.9-3.6 nm**
- **Oxidant**
  - **H_2O_2**.
- **Weight Ratio Of The Oxidant Over Phenol**
  - Range **2:1 to 1:2.**
- **Conversion Percentage Of Phenol in the Reaction**
  - Range **10-40%.**

•The prepared catalyst exhibited a significant
- •Phenol conversion of **24.9%**
- •towards hydroxylation of phenol
- •hydroquinone **(78.2%)**selectively.

N2 adsorption isotherm



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