

SELECTIVE BIFUNCTIONAL CATALYST AND A METHOD OF PREPARATION THEREOF

IITM Technology Available for Licensing

Problem Statement

- Conventional synthesis of p-aminophenol (PAP) involves environmentally problematic processes, leading to challenges in various industries, including pharmaceuticals, dyes, and photography.
- Zirconium-based catalysts** have been proposed but suffer from water intolerance, sulfate ion release, and corrosion, requiring specialized equipment and increasing operational costs.
- Existing catalysts used for hydrogenation and rearrangement steps contribute to the formation of undesired by-products like aniline.
- There is therefore a **need for a bifunctional catalyst that is anti-corrosive, exhibits high conversion rates**, and facilitates a one-step hydrogenation and rearrangement of nitrobenzene to PAP.

Technology Category/ Market

Category- Chemicals, Catalysts, Solid acid catalyst

Applications- Pharmaceuticals, Dye and Pigment Industry, Manufacturing: Zirconium phosphate solid acid catalyst, Catalysis Research

Industry- Pharmaceuticals, Chemical Manufacturing, Environmental Remediation, Material Science.

Market- In 2023, the global chemical catalyst market size was USD 6481.8 million and it is expected to reach USD 9509.1 million by the end of 2029, with a **CAGR of 5.6%** during 2023-2029.

TRL (Technology Readiness Level)

TRL - 4: Technology Validated in Laboratory

Research Laboratory

Prof. P. Selvam, NCCR & Dept. of Chemistry

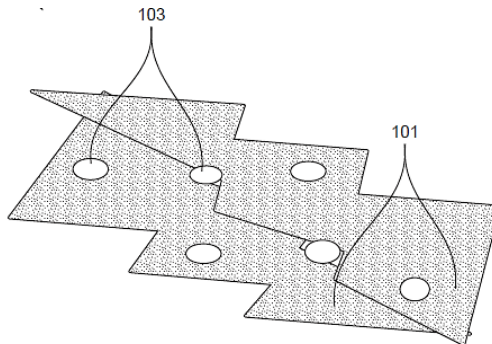


FIG. 1 Depicts a M- ZrP catalyst.

Intellectual Property

- IITM IDF Ref. 1618**
- IN 359054 - Patent Granted**

Technology

- The present invention relates to a **selective bifunctional (M-ZrP) for selective liquid phase catalytic hydrogenation of reactants and a method for preparation.**

- The M-ZrP catalyst (Fig. 1) includes 0.2 to 0.4 wt.% of a hydrogenation noble metal supported on zirconium phosphate. The method of preparation is disclosed in figure 2A.
- The M- ZrP catalyst exhibits an amorphous structure a **surface area in the range of 4 - 5 m²/g.**
- A **single pot method** of forming para-aminophenol (PAP) in a one-step reaction is disclosed in figure 2B.
- The method includes mixing nitrobenzene, the bifunctional catalyst and a **phase transfer agent mixing (PTA)**. Fig. 3.
- The mixture is stirred to initiate the hydrogenation and rearrangement reactions to obtain a mixture containing **paraaminophenol (PAP)**.
- The catalyst demonstrates **enhanced conversion of at least 90 % towards nitrobenzene and selectivity of at least 70 % towards PAP.**

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Key Features / Value Proposition

- 1. Bifunctional Catalyst:** A novel catalyst with combined hydrogenation and solid acid functionalities for efficient conversion of nitrobenzene.
- 2. Enhanced Catalytic Activity:** The catalyst exhibits high nitrobenzene conversion ($\geq 90\%$) and selectivity towards para-aminophenol (PAP) ($\geq 70\%$).
- 3. Diverse Noble Metal Options:** The catalyst utilizes hydrogenation noble metals such as platinum, palladium, ruthenium, or nickel, offering flexibility and broad applicability.
- 4. One-Step Reaction:** Enables straightforward formation of PAP using nitrobenzene, bifunctional catalyst, phase transfer agent (PTA), and water, simplifying the reaction process.
- 5. Phase Transfer Agent:** Utilization of N, N-dimethyldodecylamine as a phase transfer agent enhances catalytic performance.

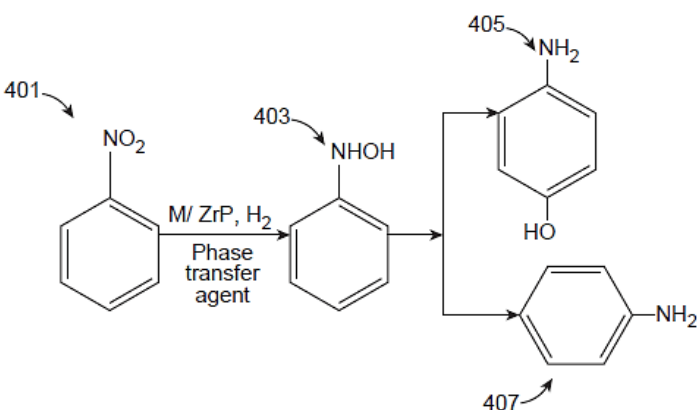


FIG. 3

FIG. 3 Depicts a reaction schematic to obtain PAP from nitrobenzene.

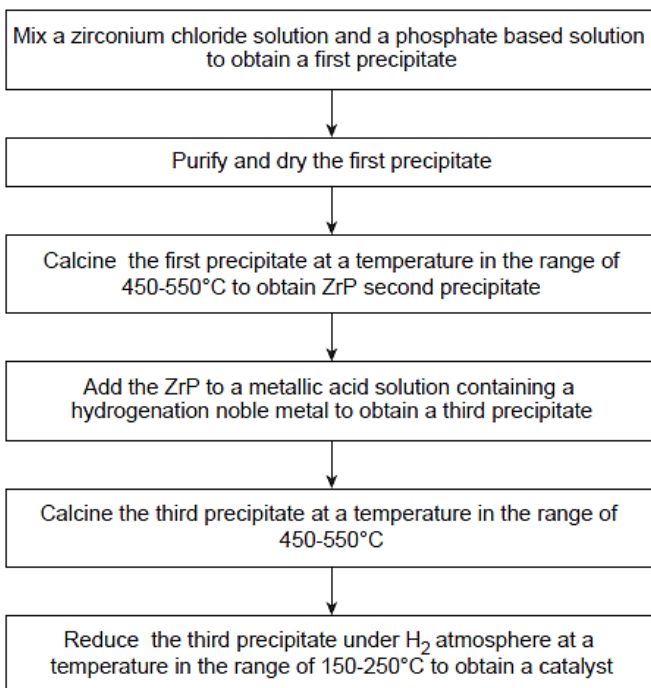


FIG. 2A

FIG. 2A Depicts a method of preparing M- ZrP catalyst.

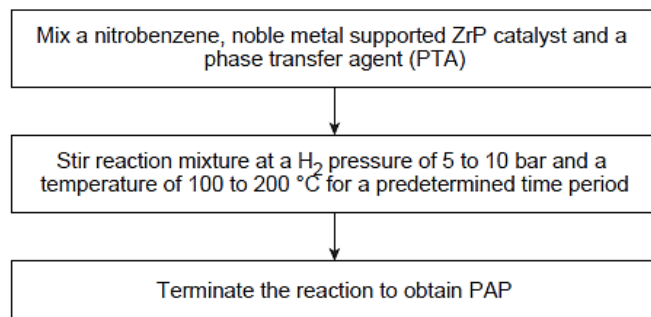


FIG. 2B

FIG. 2B Depicts a method of preparing PAP from nitrobenzene.

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