PROCESS FOR THE PREPARATION OF ORDERED MESOPOROUS TITANIA (TMP-123) WITH ANATASE AND MONOCLINIC PHASES: A NEW GENERATION PHOTOCATALYST

IITM Technology Available for Licensing

Problem Statement

- Semiconductors, particularly titania (TiO_2), are crucial for various applications including photocatalysis, gas separation, sensing, and energy conversion
- However, challenges exist in the synthesis of high-quality mesoporous titania. One of the main issues is the uncontrolled **Hydrolysis and phase separation,** and hence the risk of **collapse of the ordered mesopore structure during the removal of the surfactant** through calcination**.**
- Further, the synthesis variables affecting the quality of TiO_2 materials such as **surfactant-precursor interaction, synthesis medium, the ratio of precursor and surfactant, humidity of the environment and pH.**

Intellectual Property

- **IITM IDF Ref. 1615**
- **IN395404 - Granted**

Key Features / Value Proposition

Technical Perspective

- The invention discloses the synthesis, characterization, and photocatalytic properties of highly ordered 2D-hexagonal mesoporous titania, designated as TMP-123, using titanium tetraisopropoxide and non-ionic surfactant Pluronic P123 in *n*-butanol and acidic medium.
- The resultant clear solution has a **Ti(OiPr)4 / HCl / P123 / *n*-butanol molar ratio of 1 : 1.86 : 0.016 : 9.36.**

User Perspective

- The said material is highly ordered 2D-hexagonal mesoporous titania (TMP-123) with anatase and monoclinic mesoporous TiO_2 phases.
- The resultant material **exhibits an ordered mesoporous structure with anatase and monoclinic phases having high surface area, narrow pore size distribution, and thick pore walls.**

Technology

The present invention discloses a **with anatase and monoclinic phases and** process for the preparation of the same .

The steps for sysnthesis of highly ordered 2D-hexagonal mesoporous titania (TMP-123) include:

1. **Preparation of Pluronic P123 Solution – First solution**
2. **Preparation of titanium tetraisopropoxide Solution - Second solution**
3. **Combining First and Second Solution dropwise to obtain a clear solution**
4. **Formation of organic- inorganic mesostructure**
5. **Calcining the resultant by removing surfactant and obtaining the material.**

- The said first solution is obtained by dissolving (1.3 g) Pluronic P123 triblock copolymer (12 g) in *n*-butanol.
- Second solution is obtained by adding drops of 0.026 mol (3.2 g) conc. HCl into 0.014 mol (4.2 g) titanium tetraisopropoxide under vigorous stirring for 30 min.

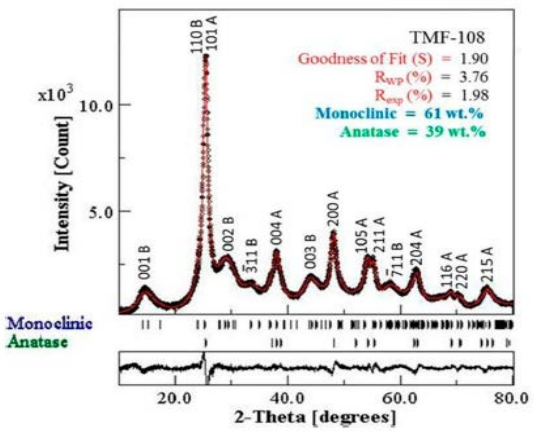

Fig. 1. Rietveld refined XRD pattern of TMP-123.

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- The resultant clear solution is poured onto Petri dishes with uniform thickness and allowing the solvent to evaporate in a hot oven at 45°C for 7 days during which self-assembly is triggered.
- The formation of organic-inorganic mesostructure takes place with hydrolyses and condensation of inorganic precursor into a mesoporous networkcan be finally calcined
- The as-synthesized sample is calcined at 350°C for 4h in the air at 0.5°C/min to remove the surfactant and obtain highly ordered 2D-hexagonal mesoporous titania, **i.e., mesoporous TiO2 (TMP-123).**

TRL (Technology Readiness Level)

TRL-3, Experimental Proof of Concept

Research Lab

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Technology Category/ Market

Category – Advance Materials and Manufacturing

Applications –Catalysis, Paints, Diagnostics, Cosmetics Drug Delivery Systems,

Industry- Nanotechnology, Chemicals, Manufacturing, Healthcare

Market -The global microporous and mesoporous materials market size was **USD 8,601.7 million in 2021**. The market is projected to touch **USD 14,930 million** by 2028 exhibiting a **CAGR of 8.2%** during the forecast period.

Images

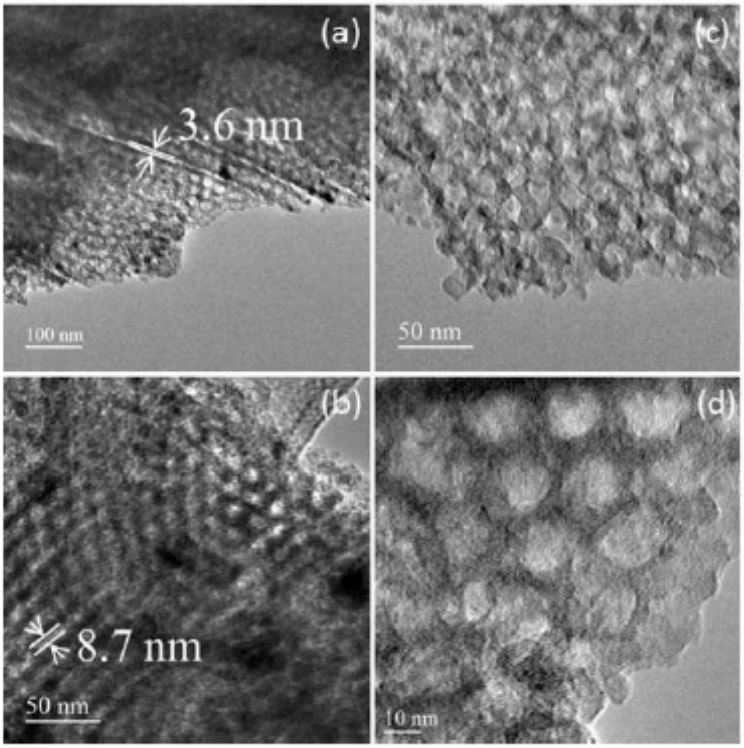

Fig. 2. (a), (b), (c), and (d) show the TEM images of TMP-123 with ordered mesopore structure.

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