VISIBLE LIGHT-DRIVEN ORDERED MESOPOROUS TiO_2 AND ITS TCPP-FUNCTIONALISED PHOTOCATALYST FOR COMPLETE MINERALIZATION OF PHARMACEUTICAL CONTAMINANTS IN WATER

IITM Technology Available for Licensing

PROBLEM STATEMENT

- There is growing concern over **pharmaceutical and organic pollutants**, such as famotidine (FAM) and its by-products, in surface and groundwater, which can negatively impact human health, wildlife, and ecosystems.
- **Wastewater treatment plants** (WWTPs) often fail to fully remove these contaminants, allowing them to enter water bodies and potentially drinking water. As a result, there is a significant push to enhance **water treatment technologies**, including the development of **advanced oxidation processes** (AOPs).
- Semiconductor photocatalysts like **titanium dioxide** (TiO_2) have shown potential for sustainable water treatment due to their low cost, stability, and non-toxicity. However, TiO_2's reliance on **UV light activation**, due to its large energy band gap, limits its efficiency, particularly in using visible or solar light.
- Although TiO_2 photocatalysis has been studied for pharmaceutical pollutant degradation, it often results in only partial removal. Furthermore, the **intermediates formed during degradation may also be harmful,** presenting an additional challenge.
- Therefore, there is a need to develop methods for the complete mineralization of FAM and its intermediates to ensure effective water purification.

INTELLECTUAL PROPERTY

IITM IDF Ref. - 2607
Patent No: IN - 539302

TRL (Technology Readiness Level)

TRL-3- Experimental Proof of concept

TECHNOLOGY CATEGORY/ MARKET

Technology category: Micro & Nano Technologies
Industry: Water treatment, pollution control
Applications: Pharma effluent treatment
Market: Pharmaceutical Waste Management Market Size can be USD 5.6 billion in 2025

Research Lab

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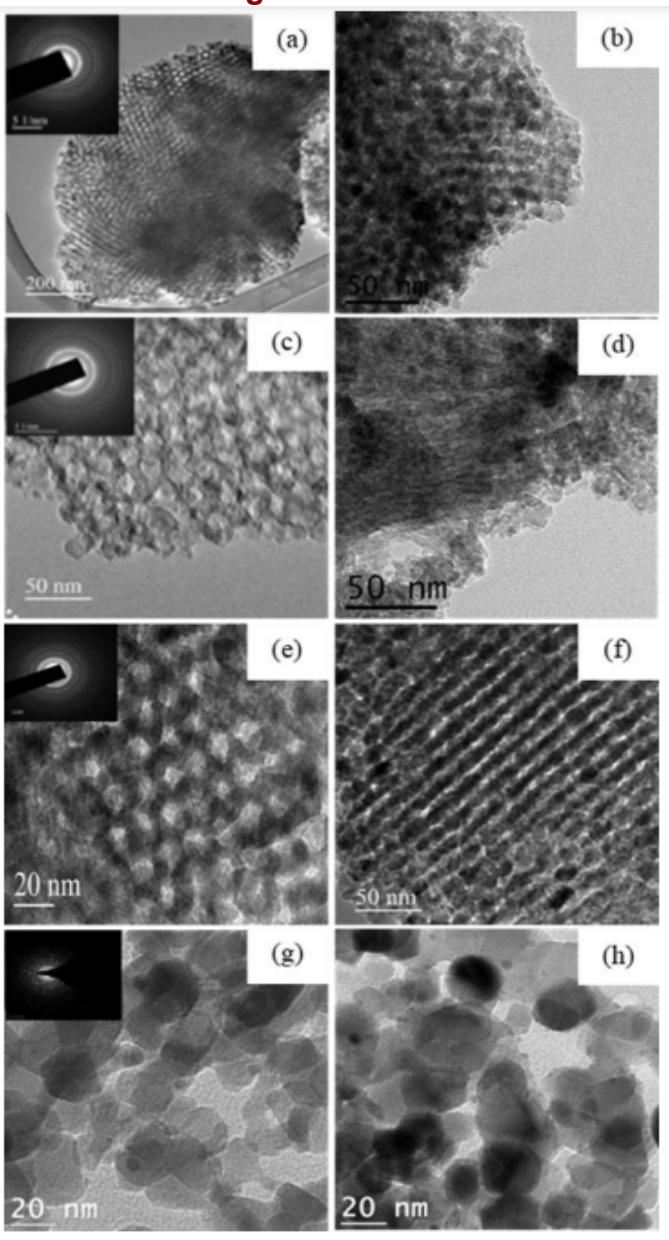
Department of Chemistry



Transmission Electron Microscopy images (a) TMF-108; (b) TCPP/TMF-108; (c) TMF-127; (d) TCPP/TMF-127; (e) TMP-123; (f) TCPP/TMP-123; (g) P-25 and (h) TCPP/P-25

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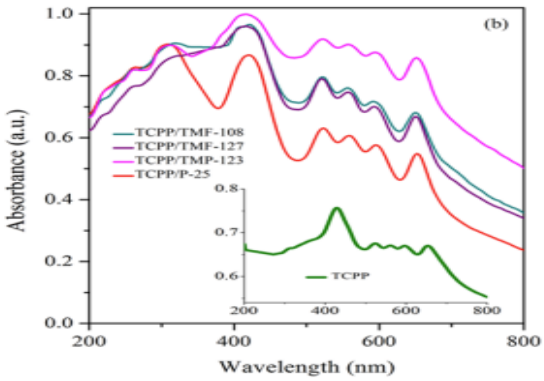
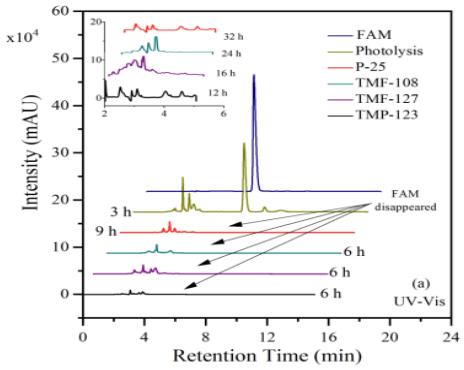
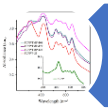


DRUV-VIS spectra of: (b) TCPP-functionalised OMTs and P-25. Photocatalytic degradation of FAM under polychromatic UV-Vis light.

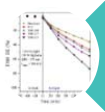


Complete mineralization under UV-Vis: (a) Photocatalytic FAM disappearance over various photocatalyst.

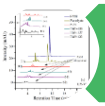
TECHNOLOGY



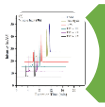
The principal object of this invention is to provide an efficient and sustainable visible light active TCPP/OMT photocatalyst(s) for the photocatalytic degradation of pharmaceutical/organic pollutant(s)



The present invention relates to a process for photocatalytic degradation of a pharmaceutical/organic pollutants such as famotidine or its intermediates, secondary pollutants.



This process is by visible light and/or UV-visible light in the presence of tetra(4-carboxyphenyl) porphyrin functionalized ordered mesoporous titania (TCPP/OMT) photocatalyst(s).



The light driven TCPP/OMT photocatalyst degrades and mineralize the pharmaceutical/organic pollutant(s).

Key Features / Value Proposition

- TCPP/OMT nanocomposites outperform conventional photocatalysts like P-25, achieving 100% degradation of famotidine (FAM) under similar conditions, showing better efficacy.
- Unlike traditional photocatalysts, TCPP/OMT composites are effective against a wide range of pharmaceutical pollutants, ideal for addressing waterborne pharmaceutical contamination.
- The TCPP/OMT nanocomposites feature a high surface area and mesoporous structure, enhancing adsorption and interaction with pollutants for more efficient photocatalysis.
- The preparation method for TCPP-functionalized OMT nanocomposites is simple, scalable, and cost-efficient, using readily available reagents and solvents for mass production.
- TCPP/OMT nanocomposites not only degrade primary pollutants but also mineralize secondary intermediates completely, resulting in non-toxic, environmentally safe by-products.

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