International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI)

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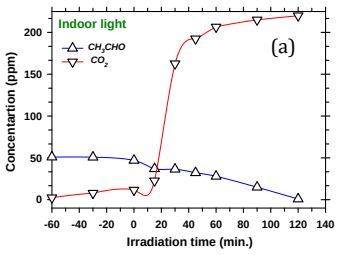
Self-cleaning Evaluation of Visible-light-driven Modified Titania for Textile Application

Overview

As part of visible-light active material developmental activity, highly visible light active photocatalysts, based on titanium dioxide nanostructure material containing carbon, C-TiO_2 core-shell nanoparticles by an in-situ Lyothermal process has been synthesized for photo catalytic self cleaning applications. Self-cleaning property of visible light photocatalysts incorporated fabric has been evaluated for the decomposition of gas phase acetaldehyde (CH3CHO) under visible-light illumination. Neither decrease in the concentration of CH_3CHO nor increase in the concentration of CO_2 is observed with commercial TiO_2. In contrast, complete decomposition of acetaldehyde observed for composite (TiO_2 with carbon nanoparticles) incorporated fabric under the illumination of indoor and outdoor light. The application of developed visible light active material could be extended to paint applications for the removal of VOCs.

Key Features

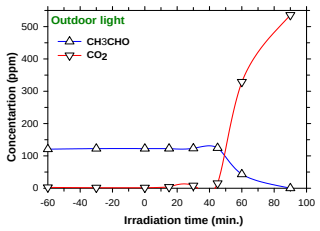
- A method of producing highly visible light active photocatalysts, C-TiO_2 core-shell nanoparticles by an in-situ Lyothermal process.
- Evaluation of photocatalytic self cleaning property of C-TiO_2 incorporated textile fabric for decomposition of volatile organic compounds (gaseous acetaldehyde).
- Photocatalytic performances of C-TiO_2 are on par with commercial visible-light driven photocatalysts for the decomposition of volatile organic compounds under UV, visible and solar light illumination



Self-cleaning performance of modified titania coated fabric under In-door light illumination.

Potential Applications

- Self-cleaning Application (textile, paint) for the removal of volatile organic compounds
- Anti-bacterial (Hospital) application



Self-cleaning performance of modified titania coated fabric under outdoor light illumination.

Technology Readiness Level (TRL): 7

- ✓ Developed a simple, cost-effective and large scale process to synthesize visible-light active titanium dioxide nanostructure material containing carbon
- ✓ Successfully evaluated for evaluated prototype sample (C-TiO_2 incorporated textile fabric) for self-cleaning photocatalytic decomposition of gaseous acetaldehyde.

IPDI*	1	2	3	4	5	6	7	8	9	10
Activities	*Basic concepts and understanding of underlying scientific principles*	*Short listing possible applications*	*Research to prove technical feasibility for targeted application*	*Coupon level testing in stimulated conditions*	*Check repeatability/ consistency at coupon level*	*Prototype testing in real-life conditions*	*Check repeatability/ consistency at prototype level*	*Reassessing feasibility (IP, competition technology, commercial)*	*Initiate technology transfer*	*Support in stabilizing production*
Status	**60 %**									

Major Patents / Publications

1. Method of producing nanostructured C-TiO_2 composite material for visible light active photocatalytic self-cleaning applications, **Indian Patent Application No. 201811011478** dated 28th March, 2018.
2. Efficient ZnO-based visible-light-driven photocatalyst for anti-bacterial applications" ***ACS Appl. Mater. Interf.*** 6, 13138-13148, **2014.**
3. Facile one step route for the development of in-situ co-catalyst modified Ti^{3+}-self doped TiO_2 for improved visible-light photocatalytic activity, ***ACS Appl. Mater. Interf.*** 8,27642-27653, **2016.**
4. *Energy Level Matching for Efficient Charge Transfer in Ag Doped Ag Modified TiO_2 for Enhanced Visible Light Photocatalytic Activity,* **J. Alloys and Compounds** *, 794, 662-671,* ***2019***

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