

# Synthesis and characterization of La-doped and La-I co-doped TiO<sub>2</sub> photocatalysts for photocatalytic degradation of Methylene Blue Dye from its aqueous solution



Thesis submitted in partial fulfillment  
for the Award of Degree

**DOCTOR OF PHILOSOPHY**

by

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*Dedicated to My Beloved*

*Parents &*

*Family Members*

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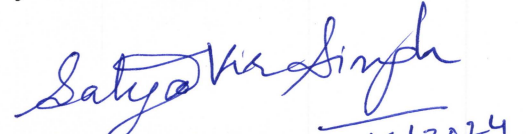
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Date:



Veeresh Verma

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## LIST OF ABBREVIATIONS

|        |   |
|--------|---|
| COD    | Chemical Oxygen Demand                                  |
| DDW    | Double Distilled Water                                  |
| DRS    | Diffuse Reflectance Spectroscopy                        |
| FE-SEM | Field Emission Scanning Electron Microscopy             |
| FTIR   | Fourier Transform Infrared                              |
| GIN    | Germination index                                       |
| IDT    | Iodine-doped TiO <sub>2</sub>                           |
| IR     | Infrared  |
| LICT   | Lanthanum (La) and Iodine (I) co-doped TiO <sub>2</sub> |
| MB     | Methylene Blue  |
| PIN    | Phytotoxicity index                                     |
| QT     | Quartz Tube   |
| RG     | Relative root growth                                    |
| SAED   | Selected Area Electron Diffraction                      |
| SCS    | Solution Combustion Synthesis                           |
| SG     | Relative seed germination                               |
| TEM    | Transmission Electron Microscopy                        |
| UV     | Ultraviolet   |
| UV-Vis | Ultraviolet-Visible                                     |
| UV-PCR | Ultra-Violet Photochemical Reactor                      |
| XPS    | X-Ray Photoelectron Spectroscopy                        |

## LIST OF SYMBOLS

|              |  |
|--------------|--|
| $C_1$        | Initial concentration of dye.              |
| $C_2$        | Final concentration of dye.                |
| $C_3$        | Loss of dye in blank solution.             |
| $C_4$        | Concentration change due to adsorption.    |
| $C_0$        | Initial concentration of the dye solution. |
| $D$          | Particle size.                             |
| $d$          | Inter-planner spacing.                     |
| $E_b$        | Electron Binding Energy                    |
| $E_k$        | The kinetic energy                         |
| $E_g$        | Bandgap energy.                            |
| $F(R\alpha)$ | Kubelka-Munk function.                     |
| $h\nu$       | Photon energy.                             |
| $K$          | Scherrer constant.                         |
| $K_p$        | Apparent first-order rate constant.        |
| $n$          | Integer.                                   |
| $R\alpha$    | Reflectance coefficient of the sample.     |
| $t$          | Time.                                      |
| $V$          | Volume.                                    |
| $\beta$      | Full width at half maxima.                 |
| $\theta$     | Diffraction angle at maximum peak.         |
| $\lambda$    | Wavelength of X-ray.                       |