

Faculty of Education
Chemistry Department

New Developed Semiconductor Nanomaterials: Preparation, Characterization and its Green Chemistry Applications

Thesis Submitted

By

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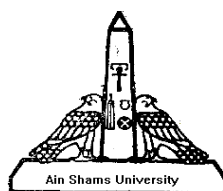
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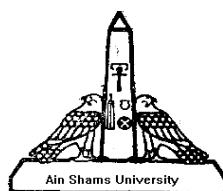
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ABSTRACT

Titanium dioxide (TiO_2) is among of the few nano semiconductors that have good chemical, mechanical, photostability and oxidation properties. The improvement of performance of TiO_2 nanomaterials can be achieved by choice method of preparation and doping with other elements. In the light of above-mentioned introduction, we have prepared TiO_2 nanoparticles by hydrothermal treatment for different times (0, 6, 12, 24 and 36h). Also synthesized pure and x mol Ln^{3+} modified TiO_2 nanomaterials ($\text{Ln}^{3+} = \text{Nd}^{3+}, \text{Sm}^{3+}, \text{Eu}^{3+}, \text{Gd}^{3+}, \text{Dy}^{3+}$ and Er^{3+} ions, x = 0, 0.005, 0.008, 0.01, 0.02 and 0.03 mol) by a sol–gel and applied these nanomaterials for industrial wastewater treatment. In addition to, the highly active nanoparticles (TiO_2 prepared by hydrothermal treatment for different times and Gd^{3+} - TiO_2 with different content) were prepared as thin film state and used in self-cleaning application.

ABBREVIATIONS

E_g	The band gap energy
<i>HOMO</i>	Highest occupied molecular orbital
<i>LUMO</i>	Lowest unoccupied molecular orbital
E°	The standard redox potentials
E_{cb}	Conduction band energy
λ	Wavelength
$h\nu$	Photon energy
e^-/h^+	Electron-hole pair
$O_2^{\bullet-}$	Superoxide radical
$OH^{\bullet}$	Hydroxyl radicals
<i>NHE</i>	Normal hydrogen Potential energy
<i>VOCs</i>	Volatile organic carbon
<i>TEM</i>	Transmission electron microscopy
<i>EDS</i>	Energy dispersive spectroscopy
<i>SEM</i>	Scanning electron microscopy
<i>PL</i>	Photoluminescence
<i>DRS</i>	Diffuse reflectance spectroscopy
<i>XRD</i>	X-ray diffraction
<i>COD</i>	Chemical oxygen demand
<i>FT-IR</i>	Fourier transformation Infrared
<i>UV-Vis</i>	Ultraviolet- visible light irradiation
<i>BET</i>	Brunauer–Emmett–Teller
S_{BET}	Specific surface area
V_m	Monolayer pore volume
r_p	Average pore size

<i>TIP</i>	Titanium(IV) isopropoxide
<i>RR</i>	Remazol Red RB-133
<i>Ln³⁺</i>	Lanthanide ions
<i>Nd³⁺</i>	Neodymium (III)
<i>Sm³⁺</i>	Samarium (III)
<i>Eu³⁺</i>	Europium (III)
<i>Gd³⁺</i>	Gadolinium (III)
<i>Dy³⁺</i>	Dysprosium (III)
<i>Er³⁺</i>	Erbium (III)
<i>pH</i>	The negative logarithm of hydrogen ions concentration
<i>TiO₂</i>	Titanium dioxide
<i>L</i>	Crystallite size
<i>k</i>	Rate constant
<i>FWHM</i>	Full width at half maximum

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