Faculty of Education
Chemistry Department

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

Thesis Submitted

By

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The Degree of
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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 (Ln^{3+} =Nd^{3+}, Sm^{3+}, Eu^{3+}, Gd^{3+}, 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
HOMO	Highest occupied molecular orbital
LUMO	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
NHE	Normal hydrogen Potential energy
VOCs	Volatile organic carbon
TEM	Transmission electron microscopy
EDS	Energy dispersive spectroscopy
SEM	Scanning electron microscopy
PL	Photoluminescence
DRS	Diffuse reflectance spectroscopy
XRD	X-ray diffraction
COD	Chemical oxygen demand
FT-IR	Fourier transformation Infrared
UV-Vis	Ultraviolet- visible light irradiation
BET	Brunauer–Emmett–Teller
S_{BET}	Specific surface area
V_m	Monolayer pore volume
r_P	Average pore size

TIP	Titanium(IV) isopropoxide
RR	Remazol Red RB-133
Ln^{3+}	Lanthanide ions
Nd^{3+}	Neodymium (III)
Sm^{3+}	Samarium (III)
Eu^{3+}	Europium (III)
Gd^{3+}	Gadolinium (III)
Dy^{3+}	Dysprosium (III)
Er^{3+}	Erbium (III)
pH	The negative logarithm of hydrogen ions concentration
TiO_2	Titanium dioxide
L	Crystallite size
k	Rate constant
FWHM	Full width at half maximum

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