Proc. of the Intl. Conf. on Nanotechnology for Better Living, 2016
Editors K. K. Kar, A. Shah and R. Sharma
Vol. 3, No. 1, p. 221
doi:10.3850/978-981-09-7519-7nbl16-rps-221

Green sol-gel route synthesis of titanium oxynitride photocatalyst for environmental remediation and H_2 generation under natural solar light

Supriya Khore[1*], Navya Tellabatti[1], Sanjay Apte[1], Bharat B. Kale[1] and Ravindra S. Sonawane[1#]

Center of Materials of Electronic Technology, Dr. Homi Bhabha Road, Pashan, Pune 411008, India
Email: #sonawaner@yahoo.com, # sonawane@cmet.gov.in, *supriyakhore3@gmail.com

The green peroxide based sol-gel route is employed to synthesize titanium oxynitride (TiON) nanoparticles (NP) at low temperature using titanium tetraisopropoxide, diethanol amine (nitrogen source), and hydrogen peroxide (reducing agent) as precursors. X-ray diffraction (XRD) show anatase phase in the undoped titania NPs as well as titanium oxynitride NPs, although with a degree of matrix disorder in the latter case (Figure 1).

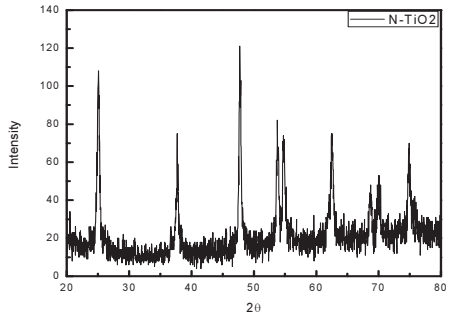

Figure 1: XRD pattern of N-TiO_2

The hydrothermal treatment of peroxide gel at moderate temperature shows crystallization of faint yellow colour anatase NPs whereas annealing of gel at different temperatures shows formation of well crystalline anatase NPs of white colour. The nitrogen escapes the O-Ti-O matrix and at 500 °C the sample becomes crystalline, looses its yellow colour and becomes white in colour. FE-SEM and TEM reveals that the particle size is in the range of 50-70 nm for the undoped TiO_2 but only 5-20 nm for titanium oxynitride (Figure 2).

Raman analysis as well as XPS techniques confirms the incorporation of nitrogen in anatase TiO_2. Optical properties such as Uv-Visible reveal an extended tailing of the absorption edge toward the visible region upon nitrogen insertion in TiO_2 matrix.

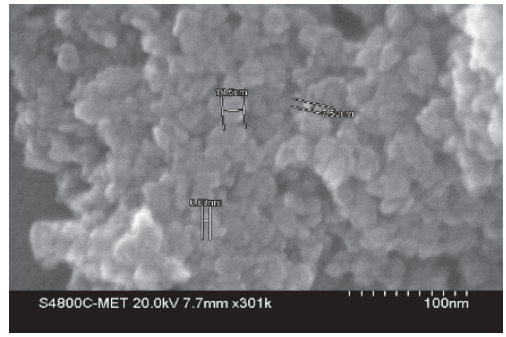

Figure 2: FESEM Image of N-doped TiO2 nanoparticles

X-ray photoelectron spectroscopy (XPS) is used to examine the electronic state of doped nitrogen and the associated possible electronic modification of the TiO_2 matrix. The activity of the TiO_2 and titanium oxynitride photocatalysts were tested for water splitting and degradation of methylene blue under visible/solar light. Under visible/solar light irradiation, the undoped TiO_2 NPs do not show any significant photocatalytic activity, as expected; however, the titanium oxynitride NPs show excellent activity to produce hydrogen from water splitting.

Keywords: sol-gel, Photocatalyst, solar light, hydrogen peroxide, degradation, titanium oxynitride

References

1. Ryoji Asahi*, Takeshi Morikawa, Hiroshi Irie, and Takeshi Ohwaki, *Chem. Rev., 2014*
2. Meng Ni, Michael K.H. Leung_, Dennis Y.C. Leung, K. Sumath