Effect of Erbium doping on photocatalytic reaction of TiO_2 under visible light irradiation

Natarajan Prakash, Rajan Karthikeyan, Dheivasigamani Thangaraju, Mani Navaneethan,
Tadanobu Koyama, Yasuhiro Hayakawa
Research Institute of Electronics, Shizuoka University,
3-5-1 Johoku, Naka-ku, Hamamatsu 432-8011, Japan
E-mail:nsprakashchem@gmail.com

[Introduction]

Organic pollutants in water and air, have become a very serious problem around the world. Photocatalysis is one of the promising friendly technique to solve this problem. TiO_2 is the best candidate because of its strong oxidation capability, photostability and low cost. However the rapid electron-hole pair recombination and poor visible light absorption are problems to be solved.[1,2] We have synthesized Er-doped TiO_2 nanostrucutures to solve the above problems and investigated photocatalytic efficiency in visible light irradiation.[3]

[Experiemental procedure]

Titanium tetraisopropoxide (TTIP, 0.5 M) was dissoved in 70 mL of 1-butanol. 0.005 M (1 %) of Erbium nitrate in 20 mL of water was added slowly to the solution and stirred for 1 h. The pale pink-colored reaction mixture was transferred to a 100 mL Teflon-lined stainless steel autoclave and solvothermal growth was carried out at 150 ºC for 25 h. The resulting product was dried and annealed at 350 ºC. To estimate the photo catalytic efficiency, the catalyst (75 mg) was suspended in 50 mL of Rhodamine B (10 ppm) solution and stirred for 45 min in the dark. The absorbance of the solution irradiated with a visible light source was measured at constant time intervals.

[Result and Discussion]

Fig 1 (a) shows the XRD patterns of TiO_2 and TiO_2:1.0Er. The peaks were well matched with anatase phase Titania (JCPDS No. 21-1272). UV-Vis results (Fig 1 (b)) showed that the absorption edge of TiO_2 slightly shifted towards visible light region because of Er doping. The Er- doped TiO_2 catalyst had characteristic Er absorptions located at 490, 523, and 654 eV which corresponded to the transition of 4f electron from $^4I_{15/2}$ to $^4F_{7/2,}$ $^2H_{11/2}$, and $^4F_{9/2}$, respectively. The photocatalytic degradation (Fig 1 (c)) results showed the higher photocatalytic efficiency of TiO_2:Er compared with pure TiO_2. The higher photoactivity under visible light might be attributed to the transitions of 4f electron of Er^{3+} and red-shift in the optical absorption edge of TiO_2 by Er doping.

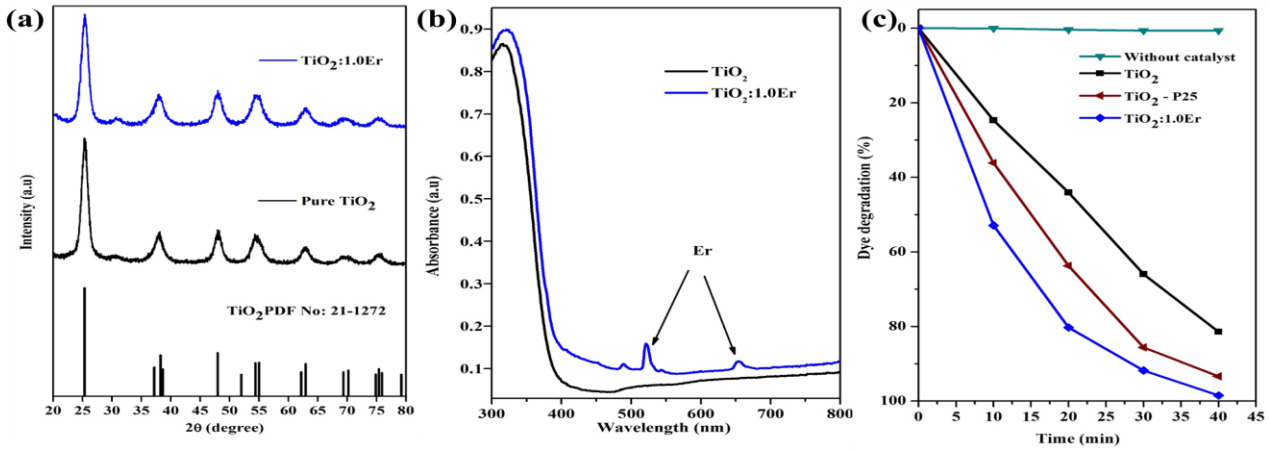

Fig.1: (a) XRD patterns, (b) UV-Vis absorption spectra, and (c) dye degradation curves of pure TiO_2 and TiO_2:1.0Er.

References

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