Erbium doped TiO_2 photoanodes for efficient dye sensitized solar cells

Navjyoti, Aman Mahajan#

Department of Physics, Guru Nanak Dev University, Amritsar-143005, India.
#Email: aman.phy@gndu.ac.in

Abstract: An increased call for energy due to industries, household use etc. could not be fulfilled via standard resources and hence alternative energy resource is needed. Due to the non-vanishing and renewable properties, solar power generation has emerged as one of the most rapidly growing renewable sources of electricity. [1] Photovoltaic cells convert sunlight into electricity via photovoltaic effect. There are three generations of fabrication of solar cells from conventional silicon (Si) solar cells to dye sensitized solar cells (DSSCs). The DSSCs are the most promising alternatives among different generation solar cells due to their low cost and ease of fabrication. [3] In DSSCs, dye molecules acts as sensitizers and absorbs the incident light. However, it has been observed that the dye molecules absorbs only the visible region of solar spectrum as their band gap lies in that region, thus, limiting their wavelength absorption and the rest of the energy has been wasted. [4] Recently, research has been focused on extending the light absorption to cover the wide range of the solar spectrum. Upconversion, non-linear and two steps optical process, has been extensively investigated as one of the capable process to convert the low energy photon (Near infrared region (NIR)) to high energy photon (Visible) through doping of upconversion nanoparticles mainly rare earth transition metals. In this phenomenon, two low energy photons (NIR) are absorbed leading to the emission of higher energy photon (Visible light) via Addition de Photons par Transferts d'Energie (APTE) effect and 2-step absorption. [5, 6]

In the present work, TiO_2 photoanodes, prepared by doctor blade method, have been doped with erbium (Er^{3+}) with different doping concentrations through hydrothermal method. The structural properties of the doped samples have been studied by X-Ray diffractometer and the optical measurements have been done through UV-VIS-NIR spectrophotometer, photo luminescence (PL) spectrophotometer and Raman spectroscopy. The DSSCs have been fabricated using Er^{3+} doped TiO_2 photoanodes and photovoltaic performance have been studied through solar simulator under 1 sun illumination (1.5 G 1 AM) of intensity 100 mW/cm^2.

References:

[1] Nannan Yao, Jinzhao Huang, Ke Fu, Xiaolong Deng, Meng Ding and Xijin Xu, RSC Adv., 2016, 6, 17546
[2] Mohammad Tawheed Kibria, Akil Ahammed, Saad Mahmud Sony, Faisal Hossain, Shams-Ul-Islam, Bangladesh, [ICEAB 2014]
[3] Anneke Hauch, Andreas Georg, Electrochimica Acta 46 (2001) 3457–3466.
[4] Li Liang , YangYulin , ZhouMi , FanRuiqing , QiuLeLe , WangXin , ZhangLingyun , Zhou Xuesong, HeJianglong , J. Solid State Chem. 198 (2013) 459–465.
[5] Xiaofei Qu, Yuchen Hou, Meihua Liu, Liang Shi, Mingqian Zhang, Hongbing Song, Fanglin Du, Results in Physics 6 (2016) 1051–1058.

5th International Conference on Nanotechnology for Better Living (NBL-2019), Jointly organized by National Institute of Technology (NIT) Srinagar and Indian Institute of Technology (IIT) Kharagpur; April 7 – 11, 2019 at SKUAST, Shalimar Srinagar, Jammu and Kashmir, India; Editor: Dr. M. A. Shah and Prof. P. Banerji, ISBN:978-81-939516-0-6; Published by Applied Science Innovations Pvt. Ltd., Pune, Maharashtra, India.