Synthesis and Fabrication of $WO_3/BiVO_4$ Nanoflakes as Photoanode Materials for Solar Water Splitting

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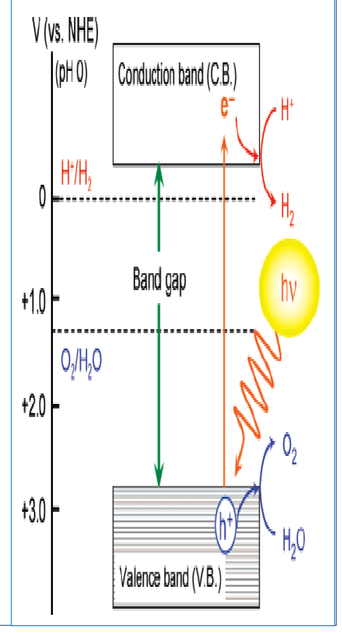
Abstract

- In this work we report hybrid synthesis of $WO_3/BiVO_4$ hetero-structured nanoarrays on ITO
- $WO_3/BiVO_4$ hybrid metal oxide nanoflakes was synthesized and fabricated on (ITO) substrate from strong acidic (pH = ~1) aqueous solution containing WO_3 and $BiVO_4$ separately.
- The photoresponse enhanced with increasing annealing temperature
- FESEM analysis showed growth of $WO_3/BiVO_4$ nanoflakes
- The peak value was 0.11 mA/cm^2



Introduction

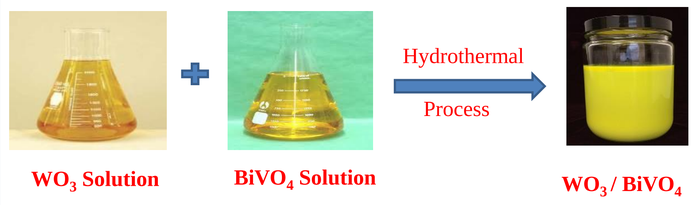
- Clean energy is one of the major problem of 21th century
- Fossil fuels is the main source of energy

Methods and Materials

Materials:

Vanadium (V) oxide V_2O_5 (99.99%), Bismuth (III) nitrate pentahydrate, $Bi(NO_3)_3.5H_2O$ (99.99%), Nitric acid (HNO_3), Tungsten (VI) chloride WCl_6 (_99.99%, Sigma Aldrich) etc.

Synthesis of $WO_3/BiVO_4$:



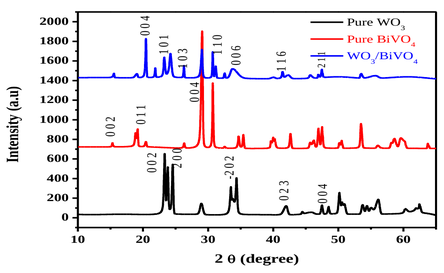
WO_3 Solution $BiVO_4$ Solution WO_3 / $BiVO_4$

Introduction

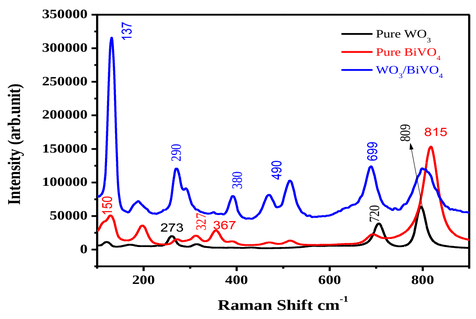
- WO_3 is n-type semiconductor with small band gap ~ 2.8 eV.
- It can capture ~ 12% of the solar spectrum (visible spectrum up to 500 nm).
- Similarly $BiVO_4$ is a n-type materials, with small band gap around ~2.4 eV.
- Relatively has negative conduction band edge (~ 0V) with low cost.

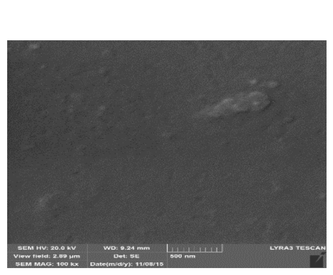
Results & Discussion

XRD analysis:

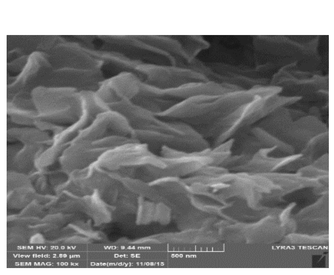


Raman spectrum:





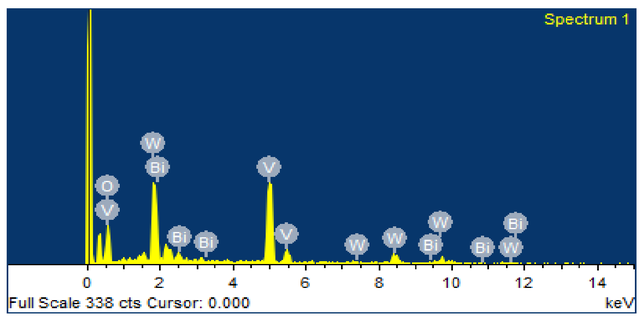
FESEM of WO_3 Seeds



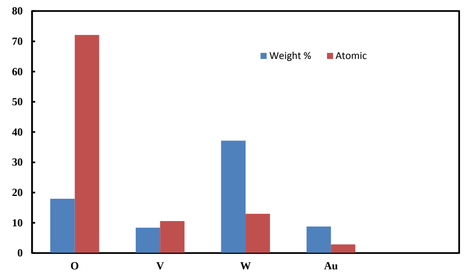
FESEM of $WO_3/BiVO_4$

Results & Discussion

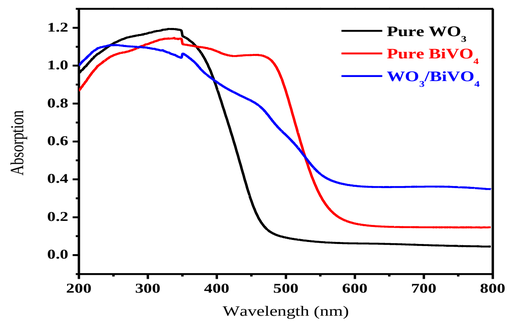
EDX analysis:



Weight/ Atomic ratio:



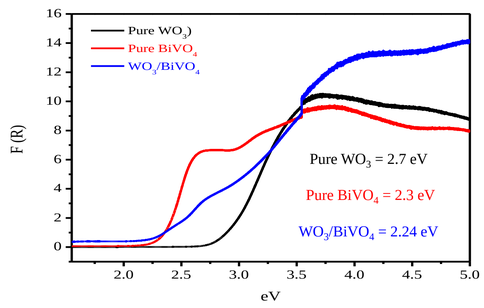
UV-Vis spectrum:



UV-Vis spectrum of pure WO_3, pure $BiVO_4$ and $WO_3/BiVO_4$

Results & Discussion

Diffuse refecltance spectrum:



Diffuse reflectance spectrums of pure WO_3, pure $BiVO_4$ and $WO_3/BiVO_4$ nanoflakes

Conclusions

- $WO_3/BiVO_4$ was synthesized from strong acidic media pH ~1
- $WO_3/BiVO_4$ with nanoflakes like morphology and band gap (2.24 eV) gave photocurrent 0.11 mA/cm^2

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1. Wang et al, J. Phys. Chem. C 2012, 116, 8901−8909
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