MoS_x/FeS/FTO ELECTRODES WITH APPLICATION IN PHOTOELECTROCHEMICAL SYSTEMS

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Introduction

Solar-induced water splitting by photoelectrochemical (PEC) cells provides an ideal solution to generate hydrogen energy, which is derived by electrochemical photolysis of H2O with semiconductors as photoanode and photocathode materials. The effectiveness of photo-driven electrolysis processes showed strong dependency on the capability of absorbing UV, visible and infrared (UV-vis-NIR) light of semiconductors, as well as their ability to suppress the rapid combination of photo-generated electrons and holes.

In this study, the photocathode consisting of MoS_3 electrocatalyst formed on earth abundant FeS_2 thin film for PEC applications was successfully prepared. The structure of the photocathode was carefully characterized by scanning electron microscopy, X-ray diffraction and UV-VIS spectroscopy. Also, the photocurrent response of the photocathode was measured under AM 1.5 illumination.

✓ Photoabsorber p-type FeS was fabricated via electrodeposition

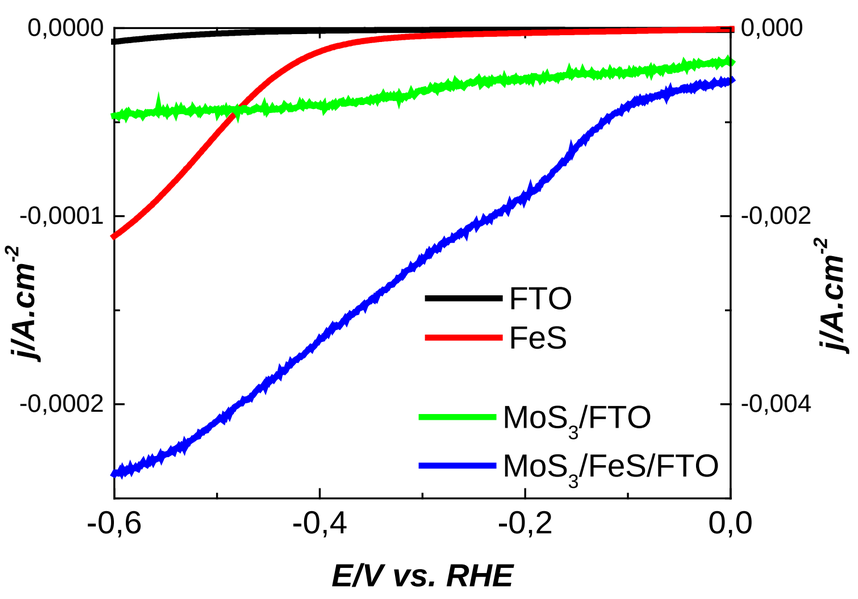
Substrate: FTO coated glass
Fe source: 0.1 mol $Fe(NO_3)_3.9H_2O$
S source:1 mol $Na_2S_2O_3.5H_2O$
E= -0.8 V; t=10 min; T=50 ^oC

✓Mos$_3$ electocatalyst was subsequently electrodeposited on FeS

Substrate: FeS coated FTO glass
Mo and S source: 0.002 mol $(NH_4)_2MoS_4$
Stabilizator : 0.1 mol $NaClO_4$
E=-0.3 V; t=60 min; T=20 ^oC

- ✓ *Use of low cost materials*
- ✓ *Short deposition time*
- ✓ *Good reproducibility*

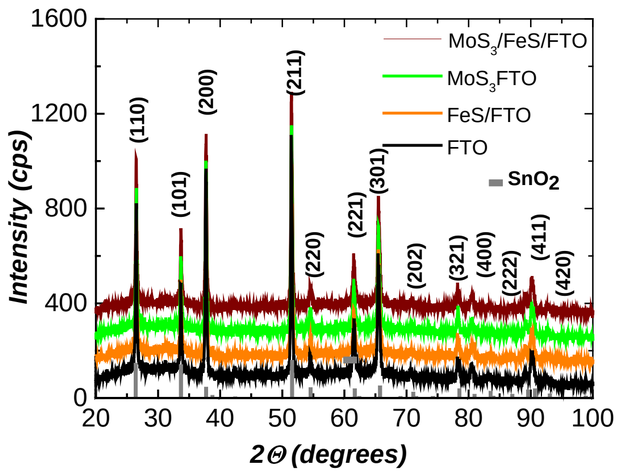
✓ The electrodes were photo-electrochemically tested



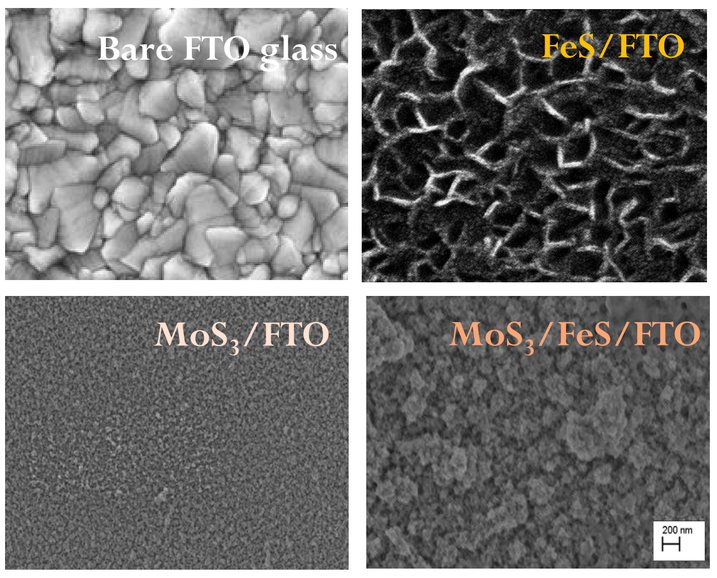
LSV curves of FTO, FeS, (x-axes) MoS_3/FTO and MoS_3/FeS/FTO (y-axes) electrodes under illumination with 1.5 sun in 0.2M Na_2SO_4

- ✓ *The FeS show photoactivity in neutral solution*
- ✓ *Addition of the MoS_3 electrocatalysts over FeS layer improve HER under illumination*

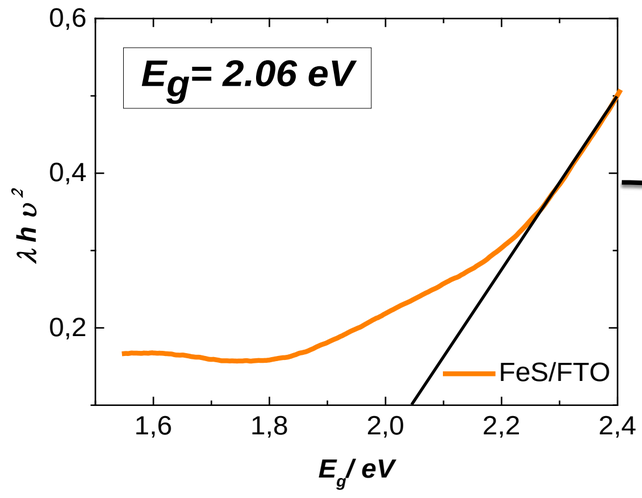
✓ Physicochemical analysis was performed



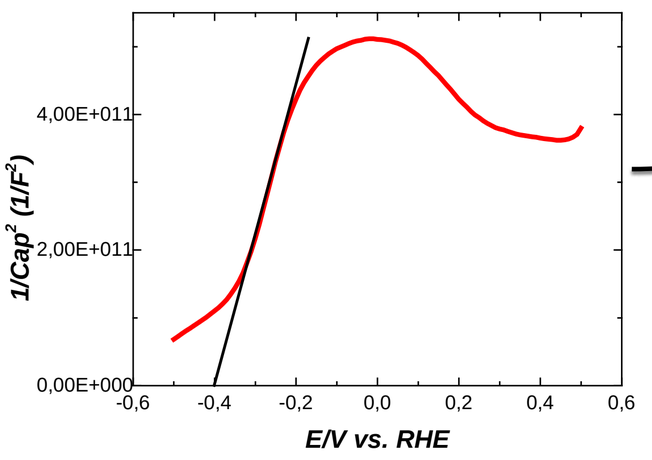
XRD patterns



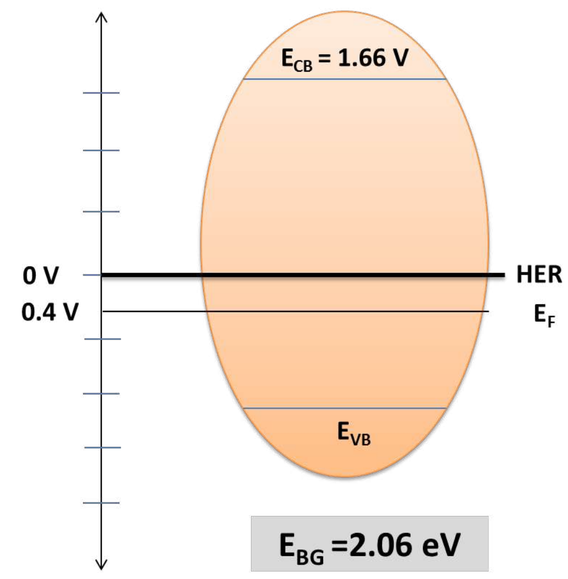
SEM images of



Tauc's plot of FeS film



Mott–Schottky plot of FeS film



Band diagram of electrodeposited FeS films

- ✓ *The FeS and MoS_3 films are amorphous*
- ✓ *The resulted FeS film is mainly composed of an aggregate of agglomerate grains with regular shapes, which are conglutinative to each other and form channels*
- ✓ *The FeS exhibit a band gap of 2.06 eV*

✓ Conclusions

✓ The FeS can be a potential candidate for photoabsorber due to its BG=2.06eV

✓ FeS provides a approx. 100 mA photocurrent in PEC system

✓ The MoS_3/FeS/FTO photocathode composed of all earth-abundant elements exhibited photo response for PEC hydrogen generation.

✓ Acknowledgments

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