Efficient Hole Injection & Transport in p-Type Oxide

Scientific Achievement

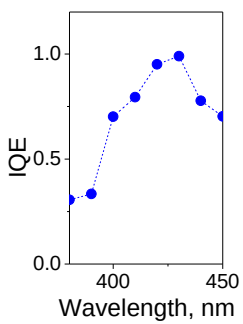
Zinc-substituted cobalt oxide exhibited >90% internal quantum efficiency for hole-injection current in thin films.

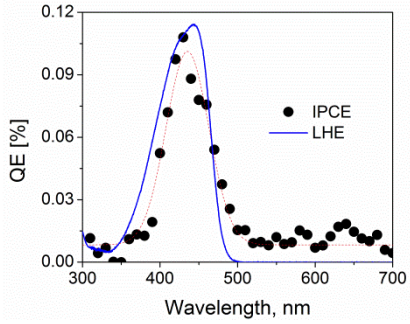
Significance and Impact

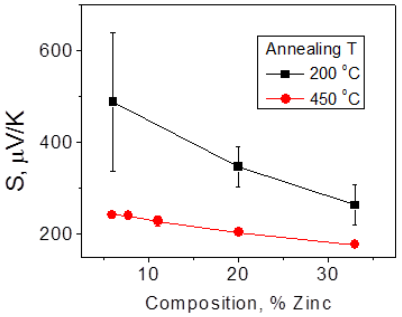
A p-type metal oxide with efficient hole injection and collection enables the development of a photocathode that is current-matched to the photoanode in a tandem dye-sensitized photoelectrochemical cell. Sufficient current generation at both electrodes will support unassisted solar photoconversion to fuel.

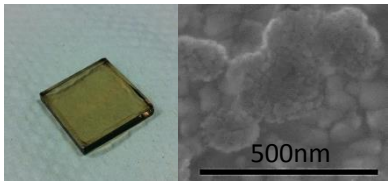
Research Details

- Sputter deposited zinc-substituted cobalt oxide (ZCO) showed high internal quantum efficiency (IQE) upon sensitization with a chromophore; however, a high surface area electrode is required and is under investigation.
- A solution-process method was developed to enable deposition of thin film of oxide on meso-structured surfaces. Analysis of the films showed zinc-substitution to be successful as Zn:Co ratio follow the intended ratio from solution. The p-type conductivity of the films also follow the trend predicted with zinc-substitution.
- Solution processed films show IQE comparable to the sputtered films.









Pictures: Thin Film of ZCO (left); Electron microscope image of film (right).

GRAPHS:
Upper left: *Efficiency of absorbed photon that is converted to current is close to 100%*
Upper right: *Efficiency of conversion of incident light to current (IPCE) and amount of absorbed light (LHE) (upper right).*
Lower: *The Seebeck coefficient (S) shows that the solution processed films are p-type and that the conductivity increases with Zn concentration and heat treatment temperature.*

C.C. Mercado, A. Zakutayev, K. Zhu, C.J. Flynn, J.F. Cahoon and A.J. Nozik, Sensitized Zinc-Cobalt-Oxide Spinel *p*-type Photoelectrode. J. Phys. Chem. C, **2014**, *118* (44), 25340–25349, DOI: 10.1021/jp508153j

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