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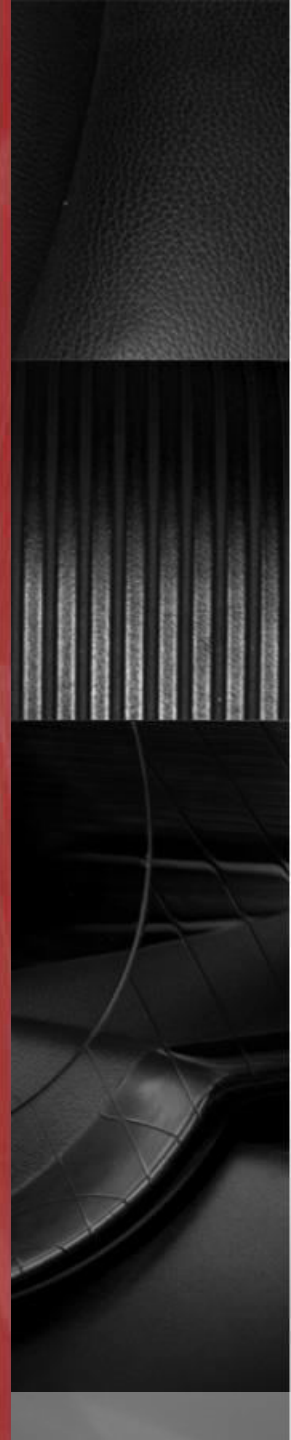
Doh-Kwon Lee



Biography

- Dr. Doh-Kwon Lee received his Bachelor's degree in inorganic materials science and engineering from Seoul National University in Seoul in 1997. He continued his studies in materials science and engineering at Seoul National University, where he obtained his Master's degree and Ph.D. in 1999 and 2005 (Advisor: Prof. Han-Ill Yoo). His Ph.D. thesis was devoted to understanding the interference effect between the ionic and electronic flow, which had long been believed negligible without experimental verification, in the mixed ionic and electronic conductors, and to elucidating the validity of Onsager's reciprocity theorem in the phenomenon of mixed ionic and electronic conduction. With his Ph.D. completed, he moved onto the Institute of Physical Chemistry, Justus-Liebig-University Giessen in Germany, where he joined Prof. Janek's research group as a senior scientist. During his period at JLU Giessen (2005-2009), he expanded his interest to the interfacial problems in functional materials, e.g., the enhanced mass and charge transport in nano-sized oxide films and the morphological instability developed at the surfaces of electroceramics, and the photoelectrochemical applications of oxide semiconductors. Since 2009, Dr. Lee has worked as a senior research scientist at Solar Cell Center, Korea Institute of Science and Technology (KIST) in Korea. The current focus of his recent research is to develop dye-sensitized solar cells, CIGS solar cells with high efficiency and photoelectrochemical cells for hydrogen production.

Research Interest

- Thin film solar cells ($CuIn_{1-x}GaxSe_2$, Cu_2ZnSnS_4, organo-metal halides solar cells, tandem solar cells)
- Photoelectrochemical hydrogen production
- Solid state electrochemical materials and devices (solid oxide fuel cell, secondary battery, oxygen separation membrane)

Photovoltaics: Multidisciplinary Science

Solid State Ionics (Defect Chemistry)

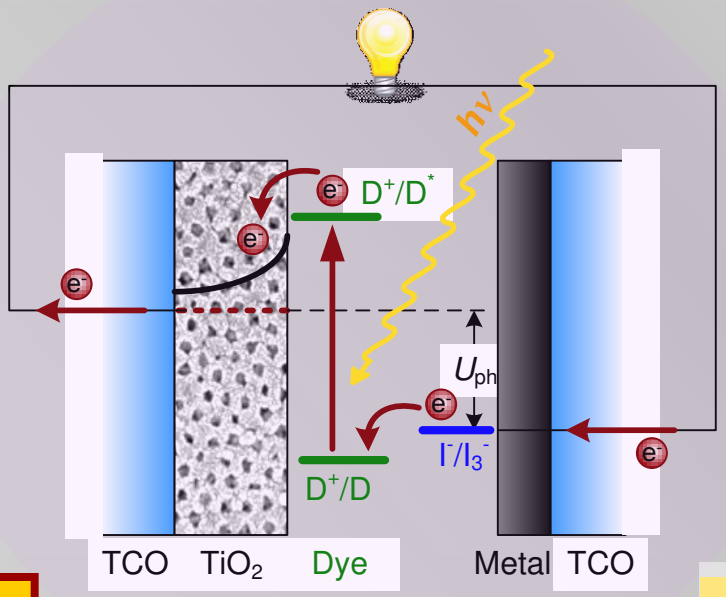
-Electron concentration
-Electron mobility
-Nonstoichiometry distribution

Semiconductor Physics

-Band-gap engineering
-Recombination

Electrochemistry

- Semiconductor/ electrolyte interface
- Electrode kinetics



Organic/Polymer Chemistry

-Design of dye

Inorganic Chemistry

- Synthesis of nano-structured electrode

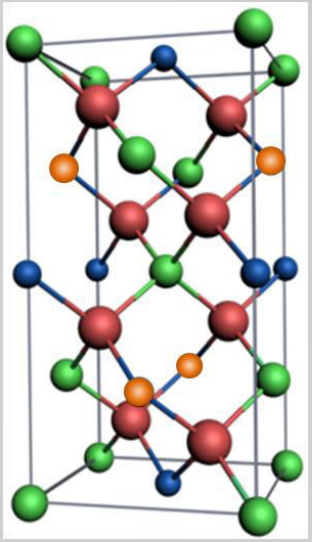
Optics

-Absorbance of light

Chemical Engineering

- Module, System

CIGS, CZTS Solar Cells



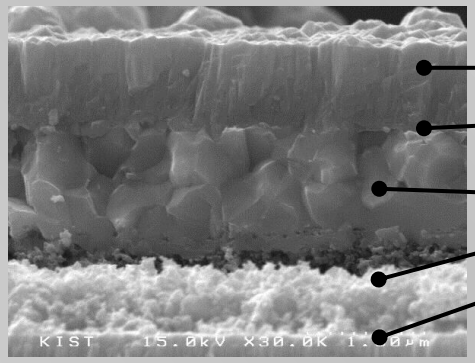
Chalcopyrite:
$CuIn(Se_{1-x}S_x)_2$

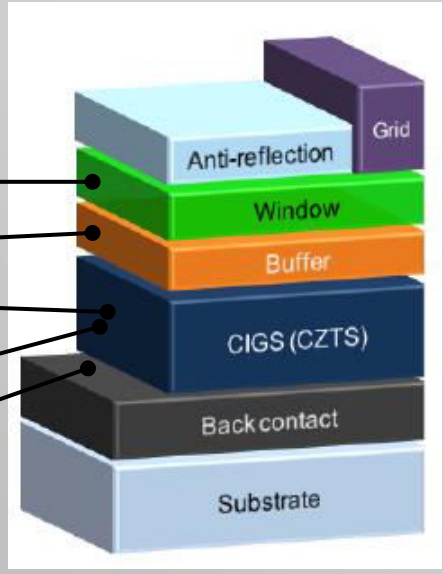
Kesterite:
$Cu_2ZnSn(Se_{1-x}S_x)_4$

Cu

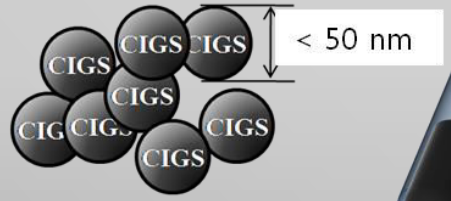
In, Zn Sn

Se, S



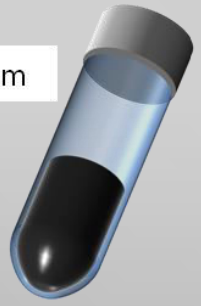


Low-cost, solution-processed thin-film solar cells

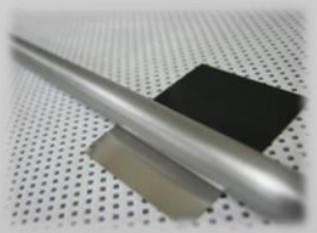


Cu-In metal, CIG-S/Se, CZTS, < 50 nm, dispersion

Nanocrystals

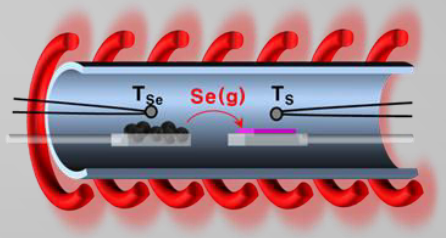


Nano-ink



Spin-casting/ Bar coating / Spray coating

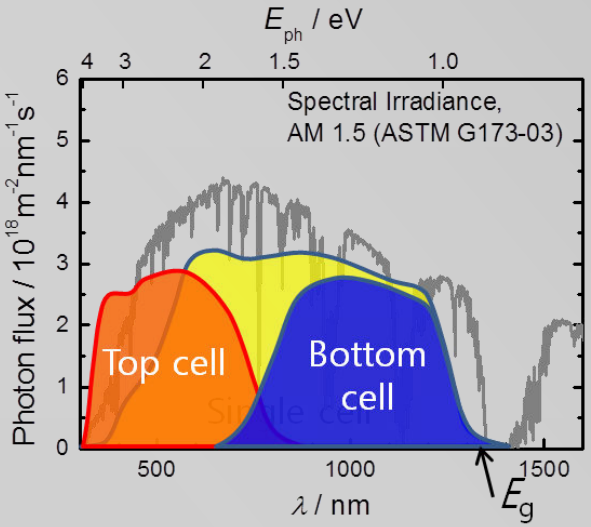
Coating



Annealing

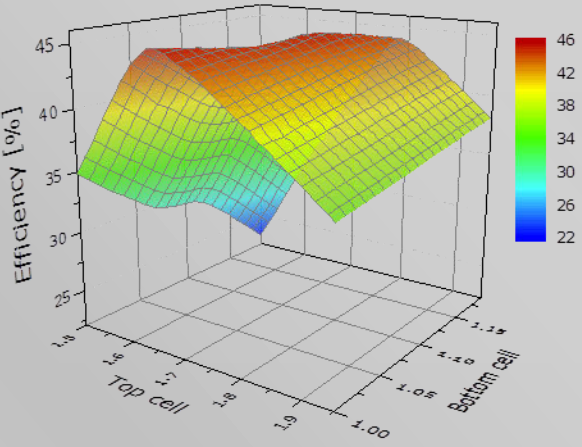
Solar cell

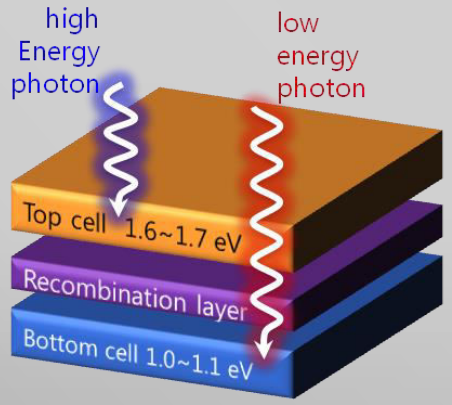
Tandem solar cells

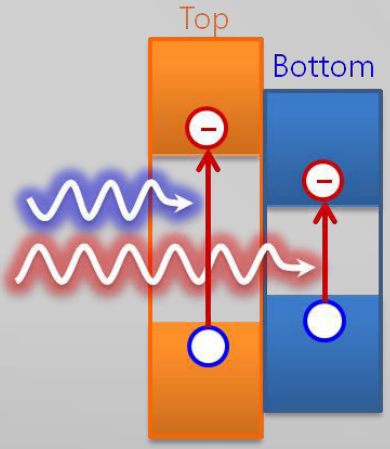


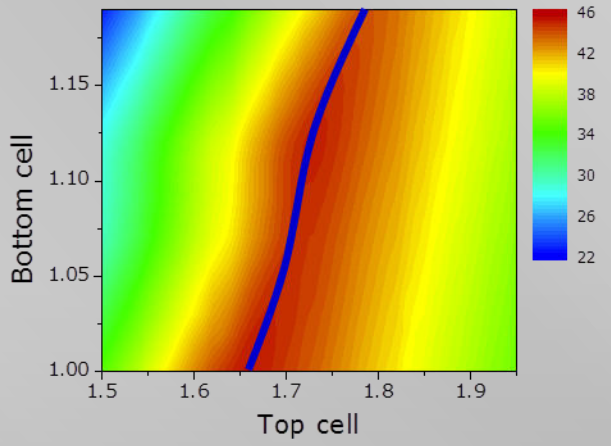
Single junction:
severe photon energy loss
by carrier thermalization

→ Multijunction (tandem) approach









Solid Oxide Fuel Cells

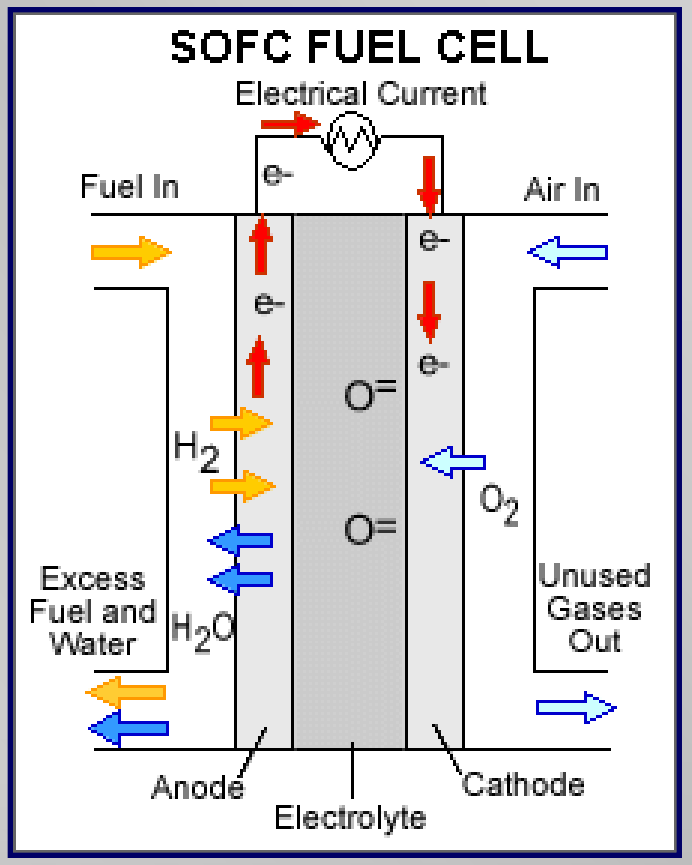
- Basic fuel cell operation
- Cathode Reaction

$$O_2 + 4e^- \rightarrow 2O^{2-}$$

- Anode Reactions

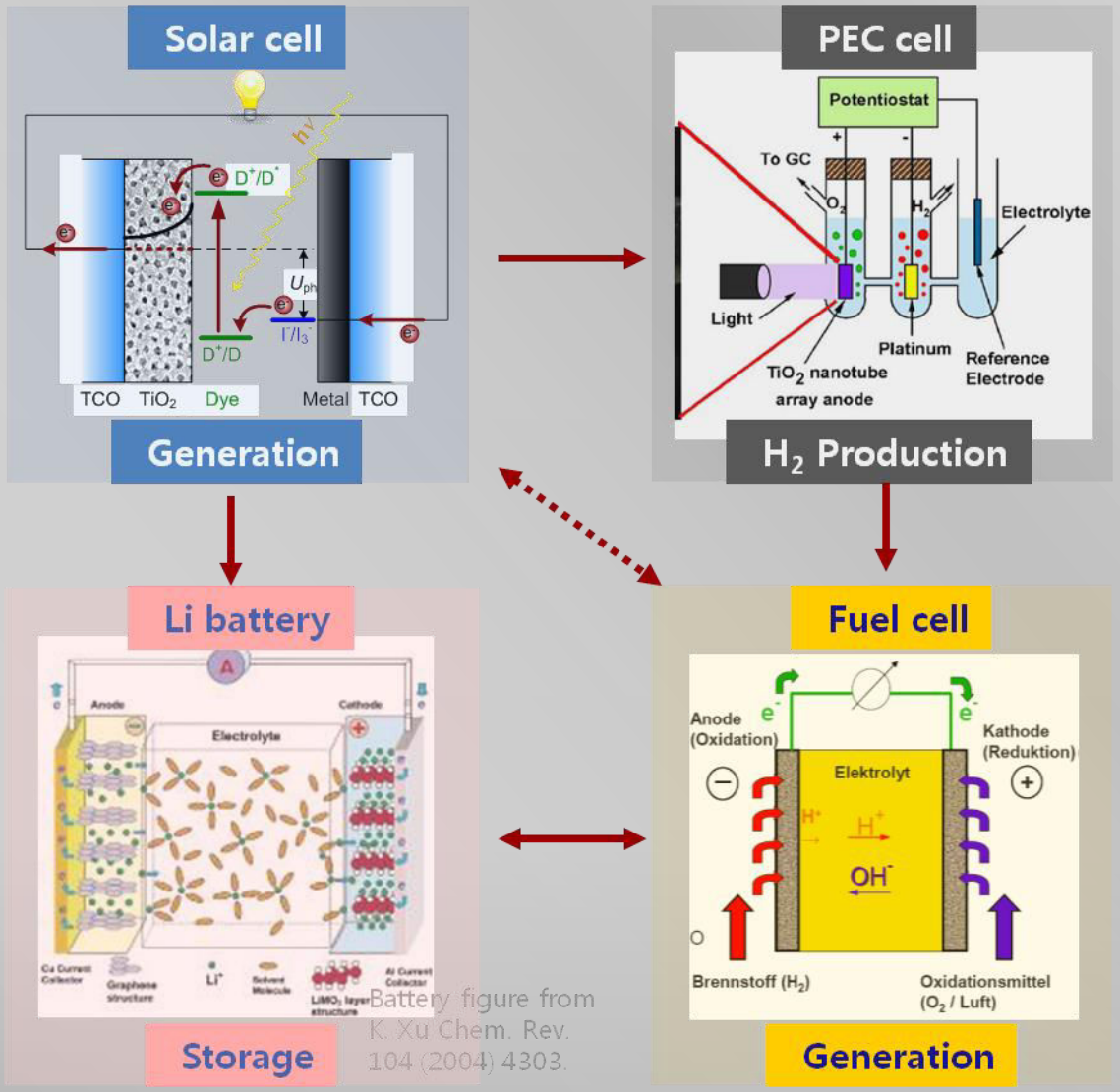
$$H_2 \rightarrow 2H^+ + 2e^-$$

$$4H^+ + 2O^{2-} \rightarrow 2H_2O$$



Taken from fuelcellworks.com

Energy Internet



Battery figure from K. Xu Chem. Rev. 104 (2004) 4303.

Signature

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- 3rd International Conference and Exhibition on Lasers, Optics & Photonics

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