

International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI)

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Solar electrochemical *nano-electrode* for H₂ generation /CO₂ conversion

Overview

Photoelectrochemical electrodes with solar photon absorptivity and long sustainability (>1000hrs) are being developed to achieve 7% solar-to-hydrogen (STH) ratio. Nanostructured semiconductors/chalcogenides and composites (CdS, CdSe, Ga-In phosphide) are being considered for the development of efficient photoelectrochemical cells (PEC). There is need to develop stable photoelectrode or improve the life of known systems (Fe₂O₃, II-VI metal chalcogenide as CdS, CdZnS). CdS/ CIGS/Si are efficient systems which need to be modified by nanostructuring for sustainable performance. This is best suited with *nano*-(Ti/Ni oxide) and *nano*-MoS₂ based systems.

Key Features

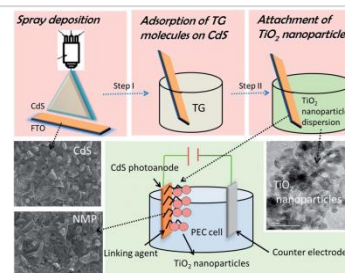
- Spray pyrolysis and Simple solution process for large electrode film deposition
- High solar absorption and improved stability
- Scalable manufacturing process

Potential Applications

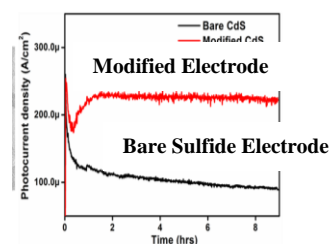
- Solar PEC H₂ generator, fuel for *cooking, cutting, welding*
- Optical material for absorber, photo-chromic display, LED, solar cell
- CO₂ conversion to usable fuel
- Pollutant removal under solar light, water purification,
- Petroleum industries

Technology Readiness Level (TRL): 4

- Performance is validated at laboratory scale
- Sustainable performance under simulated conditions
- STH of > 3% for stable performing electrodes



Simple method to obtain electrodes with improved chemical stability



Performance characteristic Nano-modified electrodes

IPDI*	1	2	3	4	5	6	7	8	9	10
Activities	Basic concepts and understanding of underlying scientific principles	Short listing possible applications	Research to prove technical feasibility for targeted application	Coupon level testing in stimulated conditions	Check repeatability/consistency at coupon level	Prototype testing in real-life conditions	Check repeatability/consistency at prototype level	Reassessing feasibility (IP, competition technology, commercial)	Initiate technology transfer	Support in stabilizing production
Status										

*IPDI : Intellectual Property Development Indices

Major Patents / Publications

1. **Borse, P.H.**, et.al. Effective Fabrication of conducting polymer modified CdS photoanodes for photoelectrochemical cell, Thin Solid Films 2018; 661(1), 84-91
2. **Borse, P.H.**, et.al. Ultrathin MoS₂-MoO₃ nanosheets functionalized CdS photoanodes for effective charge transfer in photoelectrochemical (PEC) cells, Jou Mat Chem A 2017; 5 (4), 1541-1547
3. Indian patent granted on " Method of Deposition of double perovskite of Sr Fe Nb-O film on substrate by spray coating technique & the coated substrate thereof" invented by **P.H.Borse**, - IN 2014DE01151A, Nov 6, 2015
4. **Borse, P.H.**, et.al Stable hydrogen generation from Ni- and Co-based co-catalysts in supported CdS PEC cell Dalton Transactions, 2016; 45 (27), 11120-11128
5. **Borse PH.** et.al. Nanoniobia modification of CdS photoanode for an efficient and stable photoelectrochemical cell. Langmuir 2014;30(51):15540-15549

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