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<td><strong>Author(s)</strong></td>
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Sb$_2$S$_3$-based Extremely Thin Absorber Solar Cell

Introduction
Semiconductor-sensitised nanoporous solar cells are a derivative of dye-sensitised solar cells (DSSC) where a solid-state semiconductor absorber is used in place of the molecular dye of DSSC. In particular, solid-state cells have been drawing much attention recently due to its high light-harvesting capability, tunable band gap over a wide range and a large intrinsic dipole moment. Such solid-state cells are fabricated where the semiconductor absorber is being sandwiched between interpenetrating electron and hole conductors. The typical thickness of the absorbers ranges from several nanometers to several tens of nanometers, also known as Extremely Thin Absorbers (ETA) cells.

Motivation
Solar cells have evolved through 3 generations (from silicon-based, to thin film solar cells and to the latest organic and nanomaterial solar cells). However, much research efforts are still invested in search of new materials and fabrication process. We report the fabrication of ETA cells that incorporate the advantages of both stability of thin film solar cells and printability and flexibility of organic solar cells.

1st Generation – Crystalline Silicon
- High cost
- Rigid substrate
- Rooftop

2nd Generation – Thin Film
- Lower cost
- Flexible substrate
- Building facade, window coating

3rd Generation – Organic PV and DSSC
- Extremely thin
- Printable
- Portable applications

Methodology
Except for the commercially purchased transparent conducting glass and metal electrode, the cell is solution processed with variable parameters to control the film formation. Mesoporous TiO$_2$ is formed by doctor blading while chemical bath deposition (CBD) is used to form the In(OH)S and Sb$_2$S$_3$ film.

Important Parameters for CBD
- Concentration
- pH
- Temperature

Findings
- In(OH)S is essential as a barrier layer against recombination and also serve to stabilise the formation of Sb$_2$S$_3$ above the TiO$_2$ layer which would otherwise, catalyse the formation of Sb$_2$O$_3$ instead of Sb$_2$S$_3$
- Optimal thickness of Sb$_2$S$_3$ is found to be around 10-20nm
- Decylphosphonic acid treatment improves pore filling of hole conductor

Future Work
- Replace the mesoporous TiO$_2$ with titania nanotubes array
- Study the effect of using Al$_2$O$_3$ in place of In(OH)S as a recombination barrier
- Use of other hole conductors such as P3HT and PEDOT

Conclusion
Sb$_2$S$_3$ has shown to be a promising semiconducting absorber material for new solar cell devices with good stability in air. Nonetheless, more study on its combination with other materials is required to optimise its performance and fabrication process.