Singapore-Berkeley Research Initiative for Sustainable Energy (SinBeRISE)

Programme Leader

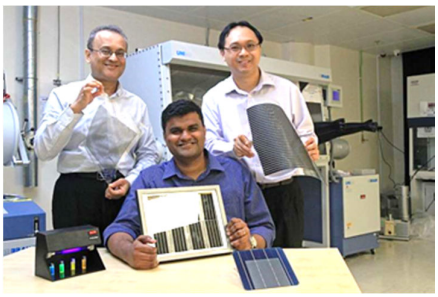
Prof Connie Chang-Hasnain

Prof. Connie Chang-Hasnain, Associate Dean of College of Engineering and Whinnery Distinguished Chair Professor of Electrical Engineering and Computer Sciences at University of California, Berkeley, serves as the Program Leader and Chief Academic Officer for BEARS since April 2015.

The SinBeRISE team consists of 26 professors from UCB, NTU and NUS as Principal Investigators guiding 71 post doctoral fellows, research associates, and PhD students.

Research Highlights

Flexible solar panels



Profs. Subodh Mhaisalkar, Nripan Mathews and Sum Tze Chien led a team that developed glass-printed perovskite solar panels that could become commercially available within the next three years. As perovskite is translucent, and its colour can also be adjusted through chemical processes, such solar panels could be integrated into building facades, which could help the Republic tap more sunlight than ever before. These perovskite panels would also be cheaper to produce, costing about three times less than conventional silicon cells.

Exotic solar cells from perovskite nanoparticles

Perovskite nanoparticles demonstrate exotic phenomena that would allow them to be utilized in “hot carrier” solar cells, allowing for extremely high efficient solar cells to be made. Reference: Nature Communications 8, 14350 (2017).

Pb free Perovskites

The team has focussed on Pb free halide perovskite semiconductors through an approach that combines high throughput combinatorial screening and experimental validation to develop Sn, Ge, Sb based halide semiconductors. Reference: Advanced Materials, 2014, 26, pp 7122-7127; Journal of Materials Chemistry A, 2015, 3, pp 23829-23832; Chemistry of Materials, 2016, 28, pp 7496-750

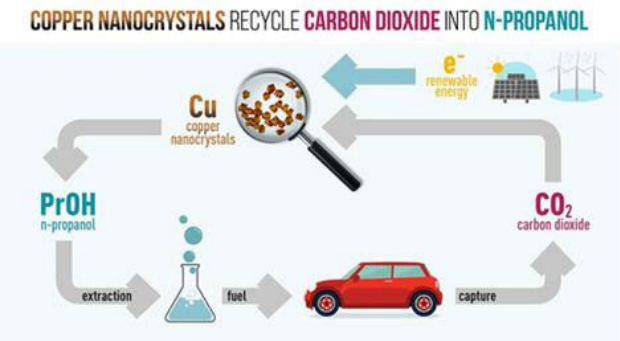
Large area printed solar panels

The team has developed large area glass-printed Perovskite solar panels that could be commercially available within the next three years. As Perovskite can be integrated into building facades, which could help the Republic tap more sunlight than ever before. These perovskite panels would also be cheaper to produce, costing lesser than conventional silicon cells. Reference: Energy Environ. Sci., 2016, 9, pp 3687-3692;

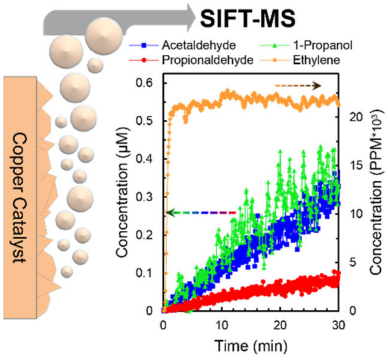
Tandem solar cells

The SinBeRISE team fabricated efficient semi-transparent perovskite solar cells which were integrated on top of conventional thin film solar cells to address different sections of the sun's spectrum boosting the overall efficiency of the devices. Reference: ACS Energy Lett, 2017, 2, pp 807–812;

Stable solar cells: The team was among the first in the world to incorporate water-repelling molecules into perovskite solar cells to ensure higher stability while maintaining good efficiency. Reference: Advanced Materials, 2016, 28 (19), 3653-3661.



Copper- based catalyst to recycle CO_2: We have developed a copper-based catalyst capable of recycling the greenhouse gas carbon dioxide (CO_2) into n-propanol, a commercially valuable liquid fuel. Agglomerates of copper nanocrystals — prepared from inexpensive and widely available copper salts was used to electrochemically reduce CO_2 at room temperature and pressure, and without the use of environmentally harmful organic solvents. The copper nanocrystals yielded 25 times more n-propanol than normal copper nanoparticles and were catalytically stable for at least six hours, with only a 14 per cent deactivation after 12 hours of reduction. With a very high octane number and energy density, n-propanol commands a higher market value than other CO_2 reduction products like methane. It can also be blended with gasoline to deliver clearer burning fuel with lower greenhouse gas emission, making the discovery a boon for the energy industry.



Selected-ion flow-tube mass spectrometry: Electrochemical CO--2 reduction (EC-CO2R) has seen a resurgence in interest over the past several years; however, the means of analyzing catalytically produced products continues to rely on decades-old methods. We have demonstrated the first use of selected-ion flow-tube mass spectrometry (SIFT MS) as an analytical tool capable of measuring in real time both the gas and liquid phase products of EC-CO2R in aqueous solution. We have evaluated this tools capabilities and show that the C1-C3 hydrocarbon, alcohol, and aldehyde products of CO2R can be quantitatively detected. Furthermore, in comparison to conventional gas chromaograph techniques, SIFT-MS can be used to fully analyze the voltage dependent performance of catalysts in hours as compared to days. The high time resolution of SIFT-MS will enable new insight into the mechanistic pathway of EC-CO2R that were previously inaccessible due to the lack of suitable analytical equipment.

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