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Green Indicator

This issue of the Green Indicator will reveal some new insight in dye-sensitized solar cells and the CatScan section will have a closer look at how to use photons to fix carbon dioxide. Perhaps this could be a way of creating the carbon-chains much needed in a future, non-oil based economy? We would also like to congratulate BASF who recently announced that they have already met their 2020 goal with respect to carbon dioxide emissions, almost a decade early. Hopefully this can be an inspiration both within BASF, setting new targets for 2020, and for other players in the business.

/ Christian Hulteberg

Cost efficient solar cells?

Over the last couple of years there has been a significant improvement in the efficiency of direct electrical solar cells. The best research cell efficiencies reported are above 40% for three-junction cells with concentrators, however there is a significant discrepancy between the research results and what may be produced in larger cells; with respect to both efficiency and cost effectiveness.

Lately, one type of cells has however gained interest and that is the dye-sensitized solar cells. The principle of this cell is that when solar radiation comes in contact with the cell, energy is transferred to the dye and excites it. The positively charged dye must then be regenerated, which is done by a Co-complex acting as a redox mediator and picking up a positive charge before diffusing to the other side of the cell to the counter electrode.

The efficiency of this type of cell, with the advantage of being transparent and versatile in color and design, saw a rapid increase from 5% to about 10% during the 1990-ies. However, little improvement has been seen since until very recently when researchers at École Polytechnique Féderal de Lausanne reported efficiencies in the 12%-range. The researchers predict reaching their 15% efficiency target within a not too distant future. However, the increase in efficiency is not the major breakthrough in the research, instead the ability of achieving this without the expensive ruthenium complexes earlier used. This achievement is of major importance and may bring this type of cell into commercial production, with high efficiencies soon.

Green Indicator #18, February 2012

Photosynthesis

A couple of issues ago, the green indicator reported on some interesting work jointly performed by a Danish/American research team on the photon-assisted splitting of water. In this issue, we'll stay in the world of artificial photosynthesis but this time turning to the other half of the reaction: the reduction of CO_2 to form CO which may be used for building up various hydrocarbons. But this article mainly wants to communicate the interesting combination of catalysis and ionic-liquids used by researchers at the University of Illinois.

As familiar, the photosynthesis uses photons for direct splitting of water into hydrogen, oxygen and electrons. The electrons generated are then used in the CO_2 fixation step, in this case for producing CO. Using 1-ethyl-3-methyl-imidazolium tetrafluoroborate to stabilize a CO_2^- intermediate the required electrochemical potential for driving the reaction could be reduced. The stabilization of the intermediate facilitated its easier reaction with H^+ at the silver electrode forming the CO. The formed CO may be stored or used for synthesizing e.g. liquid fuels with hydrogen addition.

As this example has shown, there is an interesting potential in the use of ionic-liquids in areas such as electro-chemical and catalytic chemistry. The research area is rather unexplored and there should be room for large improvements and discoveries; perhaps leading to a more sustainable energy and chemicals production.

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