NECEM SEMINAR: Nanoscale Solar Energy Converters

Prof Anders Hagfeldt, Laboratory of Photomolecular Science, Swiss Federal Institute of Technology Lausanne

2-3pm, Wednesday 6th May 2020
Newcastle University, Bedson Building, Lecture Theatre 1.75

Nanoscale Solar Energy Converters

Anders Hagfeldt

Laboratory of Photomolecular Science, Swiss Federal Institute of Technology Lausanne (EPFL), CH-1015, Lausanne, Switzerland

E-mail: anders.hagfeldt@epfl.ch

In this talk I will overview the virtue of nanomaterials for solar energy conversion using as examples dye-sensitized (DSSC) and perovskite solar cells (PSC) as well as Cu_2O photoelectrodes for hydrogen production.

Some years back we introduced alkoxy functionalized donor groups as a building block in organic dyes as light harvesters for DSSC. This donor group provides a desirable 3-dimensional structure that aids in surface protection of electrons injected into the semiconductor from oxidants in the electrolyte, allowing for record-setting cobalt- and copper-based redox shuttles to be utilized more frequently. With these systems we recently set the world record efficiency for DSSC of 12.25%. DSSCs are ideally suited for ambient light and indoor applications where efficiencies up to 35% have been reached calculated with respect to the fluorescent light source.

In our work on perovskite solar cells (PSC) we have achieved efficiencies above 23%. Through compositional engineering large perovskite grains grown in a monolithic manner are observed and reproducibility and device stability are improved. With regards to lifetime testing, we have shown a promising stability at 85 ^{o}C for 500 h under full solar illumination and maximum power point tracking (95% of the initial performance was retained). Our present main directions of developing passivation interface layers and all-inorganic perovskite materials will be discussed in the lecture.

The state-of-the-art Cu_2O photocathode employs gold as the back contact which, besides

being expensive, can lead to considerable electron-hole recombination. Recently, we presented a Cu_2O photocathode with overall improved performance, enabled by using solution-processed CuSCN as hole transport material. Owing to multiple advantages of applying CuSCN as the hole transport layer, a standalone solar water splitting tandem cell was built, delivering a solar-to-hydrogen efficiency of 4.55%.

Biography

Anders Hagfeldt is Professor in Physical Chemistry at EPFL, Switzerland. He obtained his Ph.D. at Uppsala University in 1993 and was a post-doc with Prof. Michael Grätzel (1993-1994) at EPFL, Switzerland. His research focuses on the fields of dye-sensitized solar cells, perovskite solar cells and solar fuels. From web of science February 2020, he has published more than 530 scientific papers that have received over 65,000 citations (with an h-index of 123). He was ranked number 46 on a list of the top 100 material scientists of the past decade by Times Higher Education. In 2014-2019 he was on the list of Thomson Reuter's Highly Cited Researchers. He is a member of the European Academy of Sciences, Royal Swedish Academy of Sciences, Stockholm, Royal Society of Sciences in Uppsala, and the Royal Swedish Academy of Engineering Sciences in Stockholm. He is Doctor Honoris Causa at Université Paris Diderot, France.