# CPP 16: High Efficiency Photovoltaics (joint session AKE/CPP, organized by AKE)

Time: Tuesday 9:30–10:30 Location: H3

**Invited Talk** CPP 16.1 Tue 9:30 H3

**Multi junction concepts for photovoltaics and artificial photosynthesis: Critical points of current and future high-performance solar energy conversion** — •Thomas Hannappel — Technische Universität Ilmenau, Department of Physics, Ilmenau, Germany

By far the highest solar energy conversion efficiencies have been achieved so far, when employing III-V-based semiconductor layer structures in multi junction approaches for optimum exploitation of the solar spectrum [1-3]. In these record-breaking multi-layer structures, interfaces are the most crucial parts in different regards. In devices for direct water splitting the solid-liquid interface is in particular delicate towards (photo)electrochemical corrosion and charge transfer. An interface with low-defect density between silicon and III-V compounds would be a major breakthrough and would not only add to solar energy conversion, but all kinds of opto-electronic devices.

To accelerate progress in these fields, it is essential to gain an atomic-scale understanding of critical and essential heterojunction preparation, including the complex physico-chemical processes and interface formations [4,5]. Here, we will present original analysis to scrutinise state-of-the-art preparation and to develop future solar energy conversion routes with multi junction concepts.

[1] M.M. May et al., Nat. Commun. 6 (2015) 8286 [2] A. Nakamura et al. Appl. Phys. Express 8 (2015) 107101 [3] F. Dimroth et al., Prog. Photovoltaics 22 (2014) 277 [4] O. Supplie et al., J. Phys. Chem. Lett 6 (2015) 464 [5] M.M. May et al., J. Phys. Chem. C. 118 (2014) 19032

**Topical Talk** CPP 16.2 Tue 10:00 H3

**Monolithic perovskite/silicon-heterojunction tandem solar cells processed at low temperature** — •Steve Albrecht[1], M. Saliba[2], J.P. Correa Baena[2], F. Lang[1], L. Korte[1], R. Schlatmann[1], M. K. Nazeeruddin[2], A. Hagfeldt[2], M. Grätzel[2], and B. Rech[1] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Institut für Silizium-Photovoltaik, Kekuléstraße 5, 12489 Berlin, Germany — [2]Laboratory for Photonics Swiss Federal Institute of Technology (EPFL), Station 6, Lausanne, CH 1015, Switzerland

Tandem solar cells combining silicon and perovskite absorbers have the potential to outperform state-of-the-art high efficiency silicon single junction devices. However, the practical fabrication of monolithic silicon/perovskite tandem solar cells is challenging as material properties and processing requirements restrict the device design. We achieve a tandem cell efficiency of 19.9% with an open circuit voltage of 1.78 V for the reverse scan direction with a stabilized power output of 18.1% which is one the highest reported values to date. The monolithic integration was realized via low temperature processing of the semitransparent perovskite sub-cell. The tandem cell design is currently limited by the photocurrent generated in the silicon bottom cell that is reduced due to reflectance losses. Based on optical modelling and first experiments, we show that these losses can be significantly reduced by combining optical optimization including light trapping approaches. Therefore, this study highlights the great potential of monolithic silicon heterojunction/perovskite tandem solar cells.