JOHANNES KEPLER
UNIVERSITÄT LINZ

Institut für Angewandte Physik
Univ. Prof. Dr. Thomas A. Klar

Im Rahmen des Projektseminars

Besprechung neuerer Arbeiten aus Angewandter Physik
LVA Nr. 374.008

spricht

Herr Clemens Schwaiger

Johannes Kepler Universität, Linz

über

Prospects for metal halide perovskite-based tandem solar cells

Photovoltaics (PV) is a fast growing energy source for the world. From 2009 to 2020 the average worldwide annual growth rate of PV installation was 38%, resulting in a cumulative installation of about 707 gigawatts peak power in 2020 [1]. In principle solar cells use the photoelectric effect in semiconductors to absorb incoming light and produce electron-hole pairs in the photoactive region. If those carriers are extracted from the absorber material before they recombine, they can be used to produce electric power. It is not possible for every incoming photon to be converted into electric power. This was postulated by William Shockley and Hans J. Queisser in 1966. The so called Shockley-Queisser limit gives the maximal power conversion efficiency (PCE) of a semiconductor with bandgap (E_g) when irradiated by black body radiation. This theoretical limit is around 33,7% for single absorber layer PV cells when irradiated by sunlight [2]. In the last decade, metal halide perovskite materials came up as new class of absorber materials. The perovskite materials have a special lattice configuration and typically the chemical composition ABX_3, where A and B are cations and X is a metal halide anion. Perovskite solar cells with single layer PCEs of up to 25.5% have been reported. Perovskite-based tandem solar cells use two layers of absorber material with different bandgaps in order to increase the PCE. They seem to be a proper and scalable solution in order to overcome the Shockley-Queisser limit. But those cells have some issues that still need to be resolved. These issues include degradation, environmental hazards, light management, material selection and the architecture of the cells. Today the highest reported tandem solar cell PCE is 29.5%. This is exceeding all record PCEs of single layer cells under one-sun illumination [3].

[1]: IRENA (2021), Renewable capacity statistics 2021 International Renewable Energy Agency (IRENA), Abu Dhabi.
[2] William Shockley and Hans J. Queisser (March 1961). "Detailed Balance Limit of Efficiency of p-n Junction Solar Cells". Journal of Applied Physics. 32 (3): 510–519. doi:10.1063/1.1736034.
[3]: Wang et. al. (May 2021). "Prospects for metal halide perovskite-based tandem solar cells". Nature Photonics 15: 411-425. doi:10.1038/s41566-021-00809-8.

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Meeting-ID: 944 3341 6609
Password: 069489

Datum: Fr, 14.01.2022 **Zeit: 13:45 Uhr** **Ort: ZOOM-meeting**