Dansk Fysisk Selskab

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Solar cells of CZTS (CuZnSnS) and the first working tandem cell based on a monolithic CZTS-silicon dual-junction cell.

The semiconducting material CZTS is considered as a promising absorber for a thin-film solar cell. In contrast to the other existing, commercially available thin-film cells of CdTe and (GICS) CuInGaSe. CZTS consists exclusively of non-toxic, environmentally available and inexpensive elements. All thin-film cells have an absorbing layer of a thickness of about 1 µm, while silicon absorbers usually are more than 150 µm thick, since the light absorption in silicon is an indirect transition, while it is a direct transition for all thin-film absorbers. One additional advantage is that cells of CZTS can be constructed with the well-known architecture from CIGS cells. The efficiency (solar energy input/ electric output) of the CZTS cells has advanced by 0.5 % per year and has recently reached 11 %.

The silicon cells and the commercial thin-film cells have reached a price level, where solar energy is competitive to other types of sustainable energy. The well-known silicon cells are the dominant cells on the world market and can only be improved marginally, since the efficiency is already close to the theoretical limit.

However, a straight –forward improvement is to place a CZTS absorber on top of a standard silicon, bottom cell. With a band gap of 1.50 eV CZTS is more efficiently absorbing visible light than silicon (with a band gap of 1.1 eV). The difficulties are two-fold - the silicon surface is not a perfect substrate for CZTS growth, and copper diffusion from the top-layer of CZTS is detrimental for the bottom silicon cell. We have overcome the difficulties by depositing an extremely thin barrier layer of TiN with atomic layer deposition (ALD) between the silicon surface and the CZTS layer. With this procedure the first monolithic CZTS-Si tandem cell has been produced.

Primary author: Dr SCHOU, Jørgen (DTU Fotonik)

Presenter: Dr SCHOU, Jørgen (DTU Fotonik)