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The Versatility of Mesoscopic Solar Cells

This talk will focus on recent development in our research on solid-state dye-sensitized solar cells (ssDSSC) and perovskite solar cells (PSC).

ssDSSC: We have recently shown that copper phenanthroline complexes can act as an efficient hole transporting material. We prepared ssDSCs with a novel organic dye WS-72 and $[Cu(tmby)_2]^{2+/+}$ as redox system and achieved record power conversion efficiencies for ssDSCs of 11.7%. Our best DSC efficiency of 13.1% (32% for indoor light illumination) for a liquid Cu-complex electrolyte is achieved by the discovery that the PEDOT based counter electrode can be directly contacted with the dye/TiO_2 photoelectrode. Thus, there is no space between the two electrodes minimizing diffusion limitations and fill factors up to 0.8 is achieved.

PSC: We have achieved efficiencies above 22% with a mixed composition of iodide/ bromide and organic and inorganic cations. With the use of SnO_2 compact underlayers as electron acceptor contacts we have constructed planar perovskite solar cells with a hysteresis free efficiency above 21%. Through compositional, engieneering larger preovskite 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 oC for 500 h under full solar illumination and maximum power point tracking (95% of the initial performance was retained). Recently, we have also commented on the standardization of PSC aging tests.