PCSI

Room Canyon/Sugarloaf - Session PCSI-TuE

The Future of PV

Moderator: Kirstin Alberi, National Renewable Energy Laboratory

7:00pm **PCSI-TuE-1 Progress in Hybrid Perovskite Photovoltaics and Optoelectronics***, **Joseph Berry**,* National Renewable Energy Laboratory **INVITED**

Photovoltaic devices based on hybrid organic-inorganic perovskite absorbers have reached outstanding performance over the past few years, surpassing power conversion efficiency of over 25% for single junction and present multiple paths to tandems with efficiencies beyond 30%. These efficiencies have been achieved largely via the use of solution processing of the active layer coupled to more traditional vacuum processing for contacts and interface layers. This talk will start with recent progress and challenges in hybrid perovskite solar cells (HPSCs) with an emphasis on the role of materials integration challenges needed to enable device performance, tandem processing and stability. While, this talk will highlight recent progress at NREL, the challenges of tandems based on HPSC devices, work to develop hybrid materials for other applications and to understand their basic physical properties will also be discussed. Details of material structure, synthesis, the resulting interfaces and the role of processing in creating controlling material properties will discussed. Data on the optoelectronic, spintronic and ferroelectric properties as characterized by an array of analytical tools including time resolved spectroscopy, structural studies and device level evaluation will be presented. Links from these fundamental materials properties to technologically relevant advances and suggestions for overarching research themes will be touched upon.

7:40pm **PCSI-TuE-9 On the Path Towards Tandem Junction Nanowire Based Solar Cells***, **Magnus Borgström**,* Lund University, Sweden **INVITED**

Semiconducting nanowires have been recognized as promising materials for high-performance electronics and optics where optical and electrical properties can be tuned individual. Especially, nanowires have been identified as a means to high efficiency solar cells [1, 2] using significantly reduced materials consumption due to strong geometrically enhanced light absorbing properties [3].

In order to further optimize the performance of NWPV, and integrate them on Si in a tandem junction configuration, nanowires with dimensions corresponding to optimal light harvesting capability are necessary. We developed nano imprint lithography for patterning of catalytic metal particles with a diameter of 200 nm in a hexagonal pitch of 500 nm. We found that a pre anneal and nucleation step was necessary to keep the particles in place during high temperature annealing to remove surface oxides. We intend to transfer these grown nanowires to a Si platform (existing PV), either by direct growth on Si PV, or by nanowire peel off in polymer, followed by transfer and electrical contacting, or by aerotaxy and alignment for transfer to Si. We used electron beam induced current measurements as a tool to optimize the electrostatic potential profile in nanowires, leading to 15% efficient InP nanowire solar cells, even though only covering about 10 % of the substrate surface. The optimal band gap in combination with Si is about 1.7 eV, where we identify GaInP and GaAsP as materials for development of nanowire *pn* junctions, the heart in a solar cell.

1. N. Anttu et al., Phys. Rev. B **83**, 165431 (2011)

2. J. Kupec et al., Opt. Express **18**, 27589 (2010)

3. J. Wallentin et al. Science, **339**, 1057 (2013)

4. Åberg et al, IEEE J. of Photov, **6**, 185 (2016)

Author Index

Bold page numbers indicate presenter