mcSi and CdTe solar photovoltaic challenges: Pathways to progress

ABSTRACT

Multi-crystalline Si (mcSi) and CdTe solar photovoltaic technologies have gained significant improvement. Shockley–Queisser (S-Q) limit consideration further progress of open-circuit voltage (Voc), fill factor (FF) and the efficiency of CdTe cell are anticipated. Sub-bandgap parasitic absorption, grain boundaries and back contacts recombination lessening are vital to minimize these opto-electrical losses. mcSi and CdTe heterojunction (HJ) cells' intrinsic thermal co-efficient to optical (bandgap) loss, interface and bulk defects and related thermal diffusion are possible opto-electrical limitations. Wafer based mcSi passivated emitter rear contact (PERC) and tunnel oxide passivated contact (TOPCon) over Al back surface field (Al-BSF) contact have incredibly progressed in current decades. Similar as mcSi cell, advancement of commercial CdTe cell is desired. Reviewing CdTe and mcSi/cSi (photo-physical similarity) based one hundred and fifty research papers it is comprehended that not only band aligned but also thin, transparent passivation window and electron reflector as barrier are central to minimize the shortcomings. CdTe absorber thickness-dependent Voc and fill factor trade-off while diverse window and barrier layer performance review are realized optical transparencies to electrical loss outcome. Stated opto-electrical development purpose thin absorber supportive band and lattice matching double HJ or graded CdSexTe1-x/CdTe HJ is possible realistic pathways. mcSi thin wafer is exposed to minimize bulk degradation that is caring for a stable and cost-effective PV. Finally, CdTe solar cells present limitations to laboratory design towards the best progression trails are focused. It is anticipated to limit the levelized cost of energy (LCOE).