CZTSSe: Materials and Physics Challenges

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Thin-film photovoltaic (PV) technologies led by CdTe and Cu(In,Ga)Se2 (CIGS) are enjoying growing market share, due to their high performance and cost competitiveness, in the quest for renewable energy for the future. However the reliance on non-earth abundant elements tellurium and indium in these technologies presents a potential obstacle to ultimate terawatt deployment. We recently demonstrated kesterite Cu2ZnSn(Se,S)4 (CZTSSe) solar cells, comprised of the earth abundant metals copper, zinc and tin, with world record efficiency of 9.7%. In this talk we present a comprehensive device characterization study that pinpoints the key performance bottlenecks in these cells. We find strong buffer-absorber interface recombination and low minority carrier lifetimes that limit the open circuit voltage and a high and diverging device series resistance at lower temperature that suggests a blocking back contact that may limit the fill factor. These findings help to identify key areas for improvement for these CZTSSe cells in the pursuit of a high performance terawatt-scalable PV technology.

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