Cadmium telluride solar cells: from fundamental science to commercial applications

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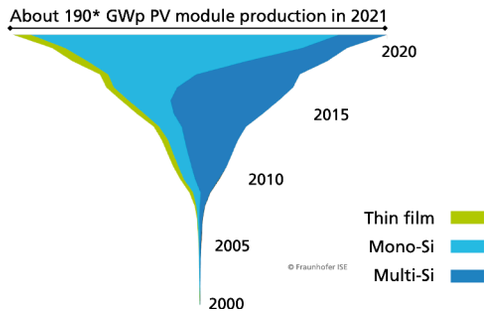
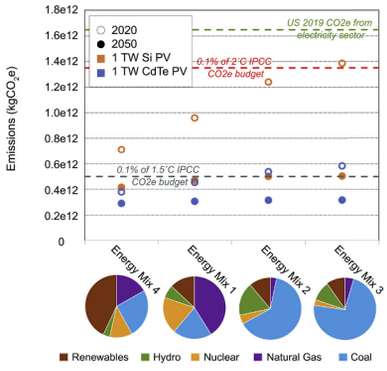
Introduction

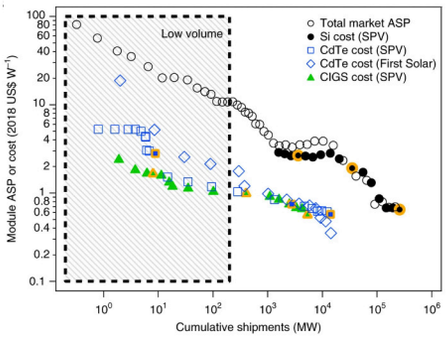
- Electrification of grid requires low-carbon energy sources
- Photovoltaics (PV) global market dominated by Si (~95%)
  - Remaining ~5% is mostly cadmium telluride (CdTe)
- CdTe has lower carbon footprint than Si, historically less expensive to produce
- CdTe makes up ~40% of U.S. utility-scale market, ~25% installations >1 MW
- Currently 10 GW/yr production, targeting 100 GW/yr by 2029
- Need to improve efficiency (address voltage deficit)



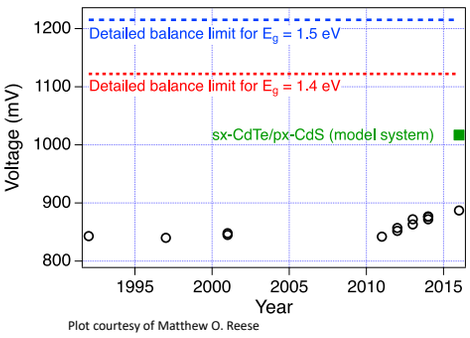
Fraunhofer Photovoltaics Report (Feb. 2023)



H.M. Wikoff et al. *Joule* **6**, 1710–1725 (2022)



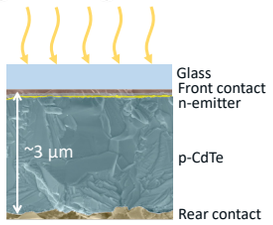
M.O. Reese, ..., D.L. McGott, et al. *Nature Energy* **3**, 1002–1012 (2018)



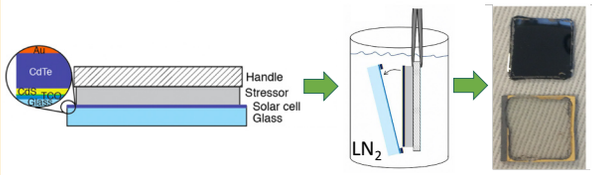
Plot courtesy of Matthew O. Reese

Understanding voltage loss

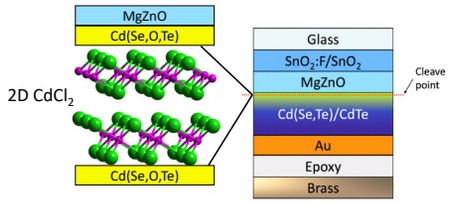
Front interface (p-n heterojunction) important but buried/inaccessible



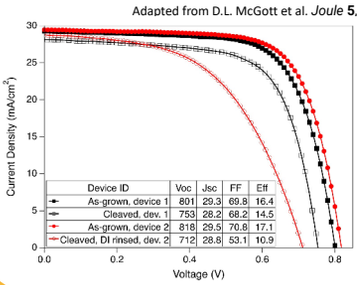
Novel thermomechanical cleave technique developed to access front interface



Adapted from D.L. McGott et al. *ACS Appl. Mater. Interfaces* **10**, 44854−44861 (2018)



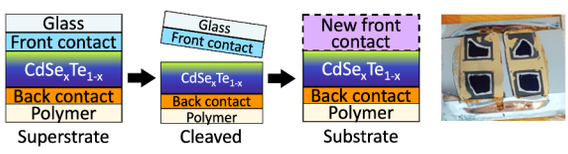
Adapted from D.L. McGott et al. *Joule* **5**, 1057–1073 (2021)



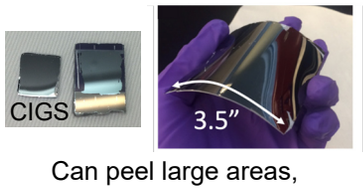
Can study and manipulate front interface in unprecedented ways

Lightweight, flexible solar

Reconstruct front contact layer(s) to make high-efficiency substrate CdTe devices

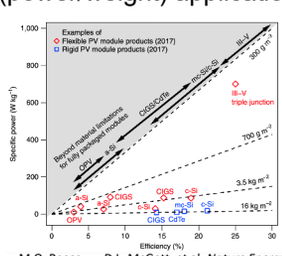


D.L. McGott et al. *ACS Energy Lett.* **6**, 12, 4203−4208 (2021)



Can peel large areas, different thin-film technologies

Inexpensive, high specific power (power/weight) applications



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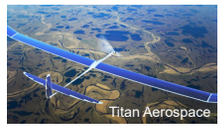

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