**BAPVC Thrust: Thin-Film PV**

**Key Challenges**

Thin-film solutions faces four significant challenges: (1) increasing efficiency of modules (particularly decreasing the gap between lab scale champion cells and production modules), (2) reducing direct materials costs, (3) reducing capital intensity of manufacturing, and (4) design and validation for long-term field reliability.

**Existing Projects in our Thrust**

- **Bandgap Grading in CZTSSe Solar Cells and SnS**, Bruce Clemens and Stacey Bent (Stanford)
- **Fundamental Modeling of Chalcopyrite Solar Cells**, Scott Dunham (UW)
- **Laser Processing of CdTe Solar Cells**, Chris Ferekides and Mike Scarpulla (USF/Utah)
- **Advanced Evaporation Source Design**, Greg Hanket (IEC)
- **Development of Multicolor Lock-in PL Methods**, Hugh Hillhouse (UW)
- **Identifying Problem Areas in CIGSe and CdTe Based PV Devices**, Mark Lonergan (UO)
- **In Situ Characterization of Grain Growth in Thin Film Semiconductors**, Delia Milliron and Paul Alivisatos (UT/LBNL)
- **Advanced Materials Characterization**, Mike Toney and Alberto Salleo (SLAC/Stanford)
- **Non-Equilibrium Processing of CdTe Absorbers**, Colin Wolden (CSM)
- **Applying Cation-Exchange Chemistry to Nanowire Array PV**, Peidong Yang (Berkeley)

**Potential New Areas of Interest**

- **Theory and Modeling**. Improved collaborative device-modeling resources that, in coordination with materials and device characterization, will inform and guide materials and device development.
- **Materials Chemistry of absorbers**. Improved understanding of defects and grain growth, and their role in metastability, composition, morphology and heterogeneities present both intra-grain and at interfaces and grain boundaries, is critical to advancing device design, process optimization, and performance.
- **Thin Film Device Architecture**. Efforts to optimize heterojunctions, interfaces, transparent conducting layers, carrier-selective contacts, and interconnects are desired. Efforts are also needed to explore means of de-coupling processes, e.g. separating of the "activation" of the absorber layer from intermixing at the CdS/CdTe interface which currently occur simultaneously during the CdCl₂ treatment.
- **Device and Materials Stability**. Collaborative research is needed to proactively test innovative device and materials stability under operating conditions (temperature, bias, and light) in order to screen for commercial viability.
- **Device Reliability**. Evaluation of packaged device reliability under combined thermo-mechanical, electro-chemical, and photo-chemical stresses in combination with commercial or BAPVC-developed encapsulants is needed to quickly identify interface adhesion issues and screen for commercial viability.
- **Low Capital Cost Manufacturing**. An expanded focus on developing new low capital cost processing routes to CdTe and CIGS would help thin film technologies compete with crystalline silicon.