Effective Doping of CdTe Towards High Efficiency Thin Film Solar Cell

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Project Objective

- CdTe highest reported efficiency 20.4%
- Objective:
  - Increase **doping concentration** while maintaining carrier lifetime

- CdTe is a defect semiconductor
- Stoichiometry of CdTe - critical to accommodate external dopants

**Diagram:**
- Cd atom
- Te atom
- $V_{Cd}^{2+}$
- $V_{Te}^{2-}$
Elemental Vapor Transport

- A process for CdTe deposition under Cd- or Te-rich conditions
- Separate zones for elemental Cd, Te and dopant

- Polycrystalline CdTe films with large grains
- Mostly (111) crystal orientation
Cd/Te Ratio Effect

- n-type or p-type films based on the Cd/Te ratio
Doping and Lifetime

- Extrinsic doping of CdTe with group V elements (Sb)
- Increase in doping concentration with Cd/Te ratio (Capacitance-Voltage measurements)

<table>
<thead>
<tr>
<th>Cd/Te</th>
<th>$\tau_2$ (ns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>5.4</td>
</tr>
<tr>
<td>1.0</td>
<td>2.9</td>
</tr>
<tr>
<td>1.4</td>
<td>1.9</td>
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</tbody>
</table>

- 2-photon TRPL measurements - lifetimes up to 5 ns for CdCl$_2$ heat-treated samples