Perovskite-Silicon Tandem Solar Cells by Scalable Spray Coating Process

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Introduction

- Hybrid process: thermally evaporated PbI₂/CsI on fully textured silicon heterojunction (SHJ) bottom solar cells
- Table top spray coater: ultrasonic nozzle, operates in ambient air
- First sprayed tandem solar cell η = 18.8%, in this work improved to 20.7%

Experimental Approach

Spray process
Substrate: SHJ bottom cell with spin coated hole transport layer (HTL) + evaporated PbI₂/CsI scaffold (∼500 nm)
Substrate temperature: 70°C
Sprayed solution: FAI/FABr in EtOH (varied molarity)

Results

I-V Characterization
- Large spread observed, difficult to identify trends
- Best cell at 18.3% after light soaking (20 min): 20.7%
- Biggest limitation due to low FF (64%), strong hysteresis
- Spin coating ref. (after light soaking): 20.7% (fabricated via hybrid route)

SEM characterization
- Inhomogeneities in surface morphology observed

XRD Characterization
- Conversion ratio calculated only used as indicator, affected by many factors!
- No clear trend visible: more complete conversion ≠ better cells

Dilution series

<table>
<thead>
<tr>
<th>Solution concentration</th>
<th>Dispense rate</th>
<th>FAI/FABr</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.075 M</td>
<td>8.9 µl/cm²</td>
<td>0.095 mg/cm²</td>
</tr>
<tr>
<td>0.065 M</td>
<td>10.3 µl/cm²</td>
<td>0.095 mg/cm²</td>
</tr>
<tr>
<td>0.055 M</td>
<td>12.2 µl/cm²</td>
<td>0.095 mg/cm²</td>
</tr>
</tbody>
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