

Contents

1	What Went Wrong with CPV?	1
1.1	Why Is CPV Losing the Race?	2
1.2	Status Update on PV	3
1.2.1	PV Is Growing—Fast	3
1.2.2	PV Is Cheap	3
1.2.3	The More It Grows, the Cheaper It Gets	4
1.3	Improving PV System Performance	6
	References	6
2	The Case for CPV	9
2.1	Operating Principles and Limits of Solar Cells	9
2.2	Solar Cells to Match the Solar Spectrum	11
2.3	Why Do We Care About High Efficiency?	13
2.3.1	Concentrator Physics: Fundamental Limits of CPV	13
2.3.2	CPV Economics	15
	References	17
3	High-Efficiency Solar Cells	19
3.1	Making High-Quality Multijunction Solar Cells	19
3.1.1	Band Gap and Absorption	20
3.1.2	Photoluminescence and Recombination	20
3.1.3	Band Gap Tunability	21
3.2	Multijunction Cells—Design and Manufacture	21
3.2.1	Lattice-mismatched Epitaxial Growth	22
3.2.2	Wafer Bonding	22
3.2.3	Mechanical Stacking	23
3.2.4	Laterally-array Cells with Spectrum Splitting	23
3.3	Towards Ultrahigh Efficiencies: Feasibility of Many-Junction Systems	23
3.4	How Many Junctions Do We Need?	24

3.5	Multijunction Cell Materials: The Big Picture	25
3.5.1	Cheaper III–V Cells	26
3.5.2	Beyond III–V—Other Materials for Low-Cost Multijunction.	28
	References.	29
4	New Approaches to CPV Optics	33
4.1	Solar Concentration: Practical Optics and Physical Limits	33
4.2	Constraints of Small Acceptance Angles	36
4.3	Relaxing Optical Requirements with New Design Approaches.	38
4.4	Light Splitting: Getting More Out of the Resource.	40
4.5	Angle Restriction and Concentration—an Emerging Concept.	43
	References.	43
5	Tracking Integration for Rooftop CPV	47
5.1	Light Collection by Tilted Panels	47
5.2	The Sun’s “Motion”	49
5.3	Sun Tracking on a Single Axis.	50
5.4	Physical Considerations of Sun Tracking 2: Tracking Errors	52
5.5	Sun Tracking Economics	52
5.6	Concentrators for the Rooftop	53
5.6.1	Optical Principles of Tracking Integrated Solar Concentrators	55
	References.	60
6	What Comes Next for CPV?	63
6.1	The New CPV	65
	Reference	68

Concentrating Photovoltaics (CPV): The Path Ahead

Apostoleris, H.; Stefancich, M.; Chiesa, M.

2018, VIII, 68 p. 24 illus. in color., Hardcover

ISBN: 978-3-319-62979-7