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PROCESS RESEARCH AND DEVELOPMENT

JET PROPULSION LABORATORY

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Processing Overview

- **1975 to 1985 progress in low cost processing has reached a plateau**
- **Current emphasis upon high efficiency**
- **New cell designs; will need process development**

Major Processing Categories

• **Surface preparation:**	**Damage removal etch** **Passivation** **A-R coat** **BSR**
• **Junction formation:**	**Diffusion** **BSF** **Edge isolation**
• **Metallization:**	**Front and back**
• **Assembly:**	**Cell interconnection** **Encapsulation** **Framing** **Cable wiring**
• **Sequences:**	**Relationships when combining individual processes**

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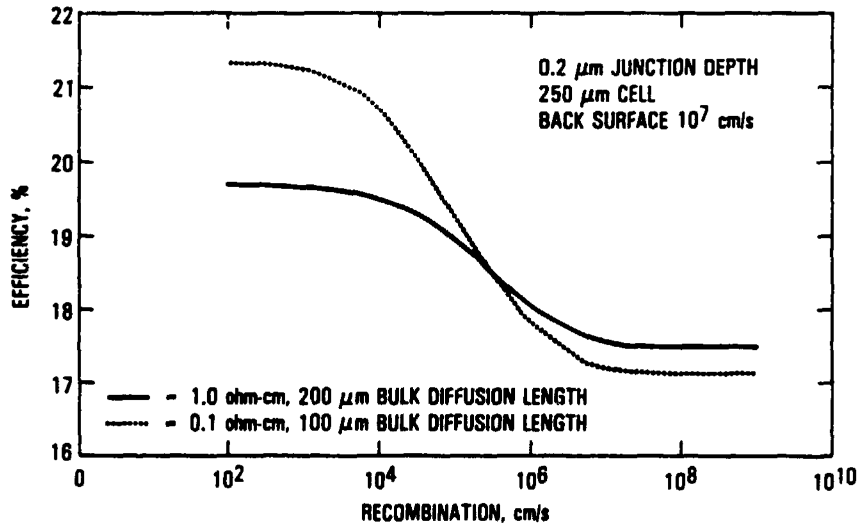
Surface Preparation

1975	1985	Future
Acid etch	Hydroxide etch	Hydroxide, then acid Etch
Polymer anti-reflection (A/R)	Texture with polymer or dieletric A/R	A/R matched to passivation
$1.22/W	$0.20/W	$0.10 to $1.00/W

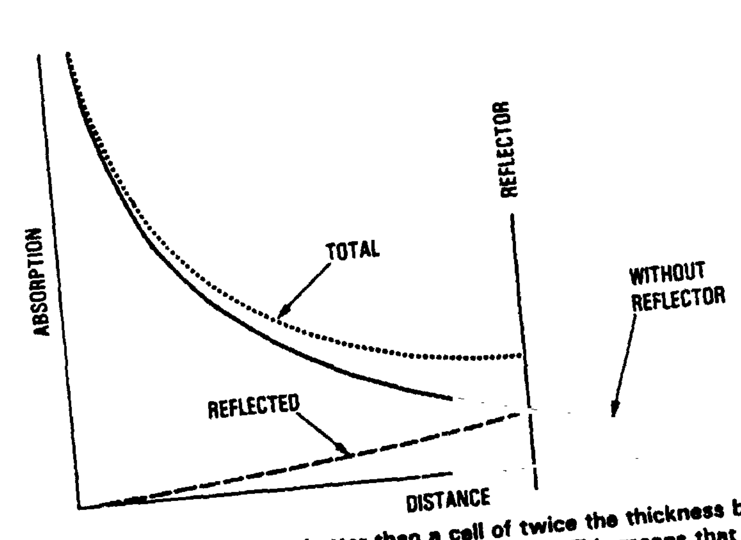
Efficiency Versus Front Surface Recombination Velocity*



When the front surface recombination velocity is brought below 10^5 cm/s, lower resistivity (0.1 Ω-cm) material outperforms 1.0 Ω-cm material even when the bulk diffusion length is less

***From E.I.H. Lin**

Back Surface Reflector (BSR)



The use of a BSR is better than a cell of twice the thickness because the reflected photons are absorbed nearer to the junction. This means that bulk material with lesser bulk diffusion length can be utilized efficiently.

Junction Formation

1975	1985	Future
0.4 μm junction	0.3 μm	0.2 μm
Ohmic back	BSF	BSR*
\$0.43/W	\$0.28/W	\$0.15 to \$1.00/W

*Not a junction process; requires surface passivation.

Metallization

1975	1985	Future
Mask and Ni plate	Screen print Ag	Laser writing plate up
Solder dip		
Full back	Aluminum back with solderable pads	Gridded back
\$1.00/W	\$0.30/W	\$0.10 to \$0.20/W

Assembly

1975	1985	Future
CZ	CZ	Ribbon
PF = .6	PF = .8	PF = .9
Interconnectors	Redundant ribbons	Redundant ribbons
Soldered	Soldered	Welded
Potted in polymer	Bonded to glass	Bonded to glass
Metal back mount	Frame mounted	Framed in field
\$5.28/W	\$0.80/W	\$0.05 to \$1.00/W

Sequences

1975	1985	Future
Acid etch	Texture	Acid etch
Diffuse	Diffuse	Oxidize
Etch	BSF	Mask front
A-R coat	Clean	Etch
Mask	Mask	Diffuse
Etch	Edge etch	Mask front
Plate	Print back	Etch back and edge
Clamp mask	Print grid	Etch front
Edge etch	Fire	Passivate front and back
Solder dip	A-R coat	Align and mask front and back
Clean flux	Test	Etch
Test		Metallize front and back
		BSR
Hand solder interconnect	Ribbon solder	Test
		Weld
Clean flux	Clean flux	Bond glass
Prime glass	Bond glass	Frame
Pot	Frame	Test
Frame	Test	
Test		
$30.00/W*	$5.00/W*	$2.00 to $10.00/W

*With yield and profit.