OVERVIEW OF PROCESSING ACTIVITIES AIMED AT HIGHER EFFICIENCIES AND ECONOMICAL PRODUCTION

JET PROPULSION LABORATORY

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Outline

• Background
• Process development concerns
• High efficiency elements
• Sensitivities
• A proposed design
• Process development for proposed design

Background

• Historically, JPL process development dealt with minimizing $/watt
• Current focus on achieving cell efficiencies greater than 18%

Process Development Concerns

• Less than optimum Si sheet
• Control of yield
• Large area cells
High-Efficiency Elements Requiring Process Development

• Bulk material perfection
• Very shallow junction
• Front surface passivation
• Finely detailed metallization

Bulk Material Perfection

• Maintain minority carrier lifetime
• High doping levels add concern
• Large area

Very Shallow Junction

• Sensitive to metallization punch-through
• Series resistance problems
• Control dopant leaching during passivation

Front-Surface Passivation

• Mechanical integrity
• Optical characteristics
• Electrical requirements
• Process selection
  • Thermal oxidation
  • Thermal CVD
  • Plasma CVD
  • Sputtering
  • Evaporation
PLENARY SESSIONS

Finely Detailed Metalization

- Aspect ratio (thickness/width)
- Laser processing
- Electrochemical deposition

Determining Sensitivity to Processing

- Use of mathematical modeling
  - Cell model SPCOLAY from University of Pennsylvania
  - Metal pattern optimization CELCAL from JPL
  - Processing models in SUPREM from Stanford University
- Experimental lab work
  - Individual process steps
  - Combine into process sequences
Power Loss vs Cell Size

![Graph showing Power Loss vs Cell Size. The graph plots POWER LOSS in mW/cm² against CELL SIZE in cm. Two lines are present, one labeled 'NOT STRAPPED' and the other 'STRAPPED.' The POWER LOSS increases with an increase in CELL SIZE. The graph demonstrates a clear trend where the POWER LOSS is higher for larger CELL SIZES.]
PLenary Sessions

Low-Resistivity Cell Behavior

A Proposed High-Efficiency Design
Process Development Required for Proposed Design

- Thinning process
- BSR optics
- Patterned doped silicon
- Metal grid alignment