Continually cited as the model for a successful industry/government consortium

The SEMATECH Model: Potential Applications to PV

Dr. Michael R. Polcari
President and Chief Executive Officer
SEMATECH
National Academies, 29 July 2009
Solar grid parity convergence

How to apply the SEMATECH consortium model to reducing costs and driving PV manufacturing to grid parity
Solar energy value chain

Driving technology innovation, productivity improvement and cost reductions across all segments
SEMATECH is about semiconductor technology innovation and manufacturing productivity

Decrease cost per function

Technology Challenges
- Lithography
- Metrology
- Devices
- Design
- Interconnects

Increase transistors per area

Productivity Challenges
- Cost per area
- Cost per wafer
- Area per wafer
- Wafer size conversion

Increase good wafer output
Reduce operating cost
Government and industry agree SEMATECH needed to regain U.S. manufacturing leadership

1987 Dual Proposals

Congress

Public Law 100-180

$100M/year (+ $100M/year from Industry)

Department of Defense/Advanced Research Projects Agency

SEMATECH

National not-for-profit consortium - five year “experiment” in public/private cooperation
SEMATECH successes

- Helped recapture US lead in semiconductors by mid-90’s
  - Focus on improving, standardizing equipment/materials infrastructure
- Instrumental in establishing/maintaining semiconductor industry roadmap
- Led industry-wide initiatives to enable multi-billion dollar industry transitions
  - Next generation patterning – advanced technology development, equipment, materials (193nm dry immersion, EUV)
  - Next wafer size – Materials readiness, equipment performance metrics
  - Screening and characterization of new materials
    - >350 material systems for high-k metal gates, >500 low-k materials
- Explored “dry holes”
  - Cost avoidance for members/industry (157nm lithography)
- The SEMATECH Effect – job creation
- Average member ROI – 5.4x
SEMATECH success factors

• Commitment from top level executives, long-term support
  – Industry and government champions
• Industry leadership
  – Government-industry partnership
• A clear, pre-competitive mission
  – Accelerate commercialization by addressing common challenges, per industry roadmap
    • Building technology infrastructure
    • Strengthening manufacturing base
• Broad representation of industry, broad network of partners
  – Chipmakers and universities, national labs (Sandia, NIST), research institutes, equipment/materials manufacturers
• Leveraging of government and industry funds
• Member-driven organization
  – Company assignees
SEMATECH ecosystem

- More than 150 research partners around the world

Chip Makers
- IDMs
- Foundries
- Fabless
- Packaging

Universities
- Funded research
- New ideas and approaches

Governments
- National Labs
- Local economic Investments

Suppliers
- Equipment
- Materials
- Software

- Today, additional opportunities in emerging technologies
  - Many emerging technologies require silicon and consortial expertise
    - Solar, MEMS, sensors…
SEMATECH and semiconductor manufacturing productivity

• **The productivity challenge**
  – How to determine, achieve, and maintain world class fab productivity
  – How to increase productivity today and into the future

• **The cost reduction challenge**
  – How to continuously reduce costs in today’s fabs
  – How to manage ever-increasing capital, manufacturing, and R&D costs

• **The sustainability challenge**
  – How to reduce our environmental footprint
    • Good for the environment, good for business
Tactical & strategic manufacturing solutions

**WHAT**
- Cost reduction
- Yield improvement
- Quality management
- Metrology
  - Defects, lithography, films
- ESH
  - Resource conservation
- Factories of the future
  - Factory automation
  - Next wafer size

**HOW**
- Fab benchmarking
- Equipment improvement teams
- Productivity workshops
- Operations/business councils
- Standards and roadmap development
- Materials screening, characterization
Councls

Benchmarking, surveys, best practices

- **Manufacturing Methods Council**
- **Quarterly fab metrics**
  - ~ 50 metrics reported
  - 20% productivity improvement in Members’ wafer fabs over two year period
- **Special benchmarking topics per member request**
  Examples:
  - Gas and chemical cost
  - Maintenance cost

Average Wafer Line Yield Per 20 Layers
Energy and resource conservation

Survey
For nearly all process tool subcomponents, energy consumption is the same whether the tool is processing or idle.
Challenges identified in recent PV Roadmap Workshop
July 12, San Francisco (DOE/SEMI)

- Organizing collaborative platforms to address common industry challenges
- Establishing and maintaining a comprehensive roadmap
- Materials, technology and manufacturing standards
- Manufacturing productivity and overall cost reduction
- Equipment improvements
- Metrology development
- Test and certification
- Defectivity and materials characterization
- Environment, safety and health
How SEMATECH can contribute to the PV industry

• Experience in:
  – **Technology development** to accelerate commercialization
    • Advanced/emerging technology R&D programs
  – **Manufacturing productivity** programs
    • Develop/harden manufacturing, metrology, and test equipment
    • ESH
  – **Collaborative strategies** to build consensus, guide industry direction
    • Roadmaps and standards
  – **Recruiting, organizing consortia**
    • Methodology for collaboration among competitors
    • Managing IP protocols
    • Coordinating programs between industry, national labs, and universities
Accelerating the next technology revolution

Research  Development  Manufacturing