

# MAGNOLIA SOLAR CORPORATION

[WWW.MAGNOLIASOLAR.COM](http://WWW.MAGNOLIASOLAR.COM)

OTC:MGLT

**Creating New Technology For A Greener Planet**

Corporate Presentation  
October 2011



# Company Profile

## Who is Magnolia Solar?



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### High-Efficiency, Low-Cost, Thin-Film Solar Energy

- **Commercializing proprietary technologies for solar photovoltaic applications:**
  - Company spun out of Magnolia Optical Technologies and benefits from over \$10 million of highly selective government R&D contracts from DARPA, NASA, DoD, NSF and NYSERDA
  - 10-year license to Magnolia Optical's advanced research in sensor technologies from the infrared (IR) to the ultraviolet (UV) for solar applications
- **Unique insights into advanced solar photovoltaic device design**
  - Multiple patents already filed, additional patents in preparation
  - Both higher current and voltage outputs can be achieved by combining Magnolia's exclusive material structures with advanced optical coatings
  - One of the industry's most aggressive efficiency and cost per watt targets
- **Accelerate product development using CNSE Albany Nanotech facilities**
  - Currently headquarters in Woburn, MA; R&D Center in Albany, NY

*Over 50 years of collective management experience in advanced technologies and solar photovoltaics (PV)*

# Product Development Activities



## Development work started at CNSE Albany Nanotech

- **Magnolia Solar is part of PVMI team and the benefits include:**
  - DoE, New York State, and private investment of over \$300 million in state-of-the-art thin-film facilities for PV product development
  - Significantly shorter commercialization cycle at a substantial cost savings
  - Access to considerable technical expertise, including SEMITECH resources
  - Substantial state incentives to locate in the New York Capital Region



# Magnolia Solar Vision: Implementation



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## High-Efficiency, Low-Cost, Thin-Film Solar Energy

*Target: Cost Goal at \$0.50/watt*

- Develop and commercialize revolutionary new thin-film solar cells employing nanostructures
  - Thin-film design minimizes semiconductor material costs
  - Magnolia innovations can dramatically improve efficiency
    - Nanostructure-based anti-reflection coating
    - Unique semiconductor device design with nanostructure insertion
    - Enhanced solar spectrum absorption and optical path in cell
  - Achieved by increasing power output to enable ultra-high efficiency without concomitant cost increase

# Competitive Advantage



- **Magnolia Solar's technological innovations include:**
  - Nanostructure-based anti-reflection coatings
    - Dramatically improve solar cell performance by minimizing reflection losses at the air/solar cell interface to less than 2%
    - Improve performance even under dusk and dawn conditions when the sun is low on the horizon
- **Nanoscale materials to broaden the range of solar spectrum captured by the solar cell**
  - Capture UV/Visible/IR spectrum energy to improve cell performance and provide power under a wide range of atmospheric conditions
  - Advanced light trapping structures to improve PV cell performance and minimize semiconductor material thickness
- **Leveraging DOE's \$58 million award to CNSE Albany Nanotech**
  - Additional \$300 million public/private investment for Photovoltaic Manufacturing Initiative (PVMI) to minimize development costs and accelerate the commercialization cycle
- **Technology development funded by government contracts**

# Funding History



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- **Received several highly competitive development contracts**
  - New York State Energy Research and Development Authority (NYSERDA) awarded two contracts
    - Product development grant to improve thin-film solar cell efficiency by expanding solar spectrum energy band absorption
    - Contract to develop nanostructure-based antireflective coatings
  - U. S. Air Force awarded two Phase I contracts
    - Contract to develop flexible, ultra-high efficiency, multi-junction solar cells for space and defense applications
    - Contract to develop third-generation, single-junction solar cells employing quantum dot structures to improve performance metrics
  - National Aeronautical and Space Administration (NASA) awarded one Phase I contract
    - Program to increase PV cell current and voltage (power output) by using quantum-structured active regions and incorporating advanced light-trapping structures

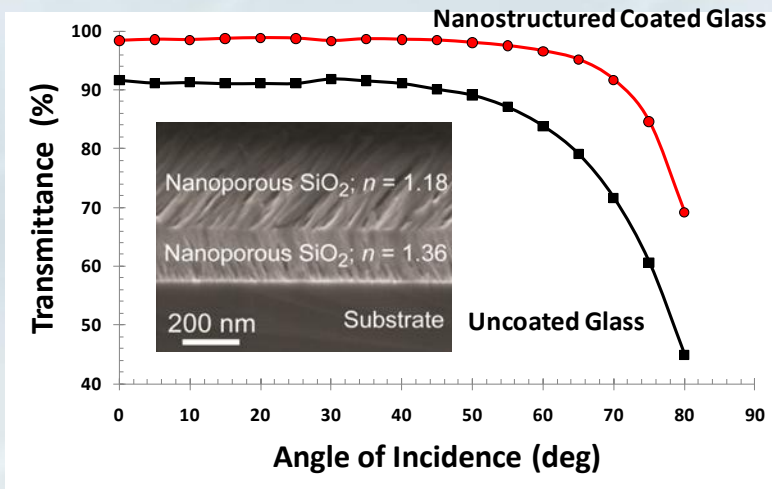
**Company R&D operations are cash neutral due to these contracts and use of the extensive nanotechnology infrastructure in the New York Capital Region**

# Patent Pending Technology

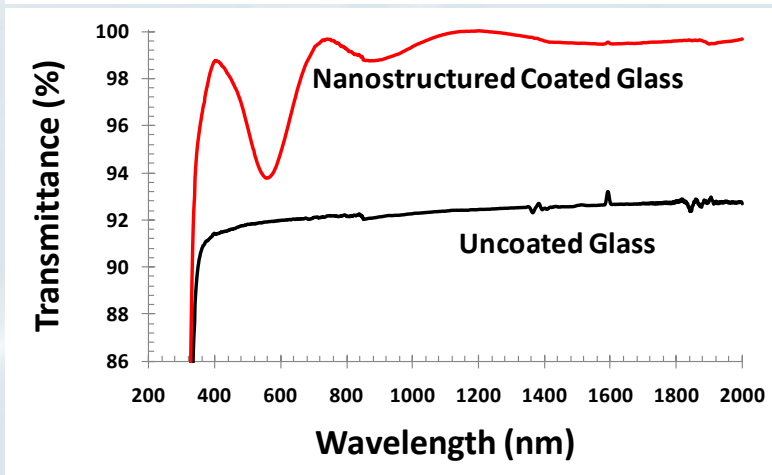
## Nanostructure-based Anti-Reflection Coatings on Glass



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- **High performance AR coatings** employ multiple layers of nanostructured material with tunable refractive index
- **Peak transmittance approaches 100%!**
- **Ultra-high transmittance** over the entire solar spectrum and a wide range of angles
- **Reduces reflection losses** throughout the day, even when the sun is low in the sky in the early morning and late afternoon
- **Results in higher current output** throughout the day, and thus higher overall power conversion efficiency

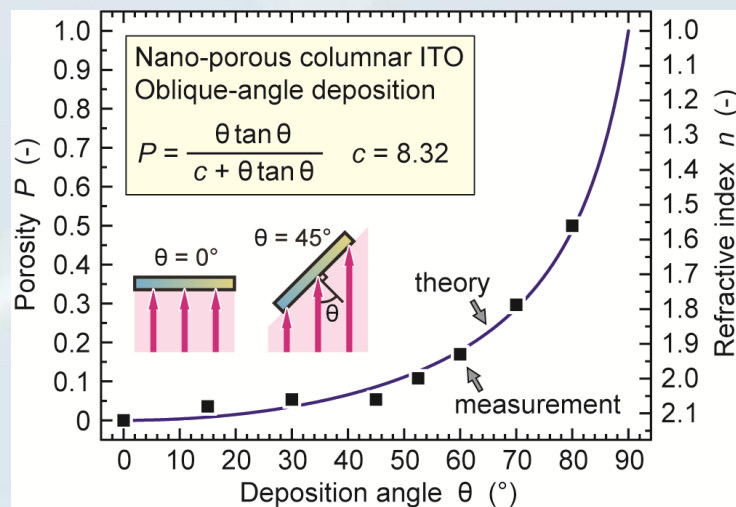
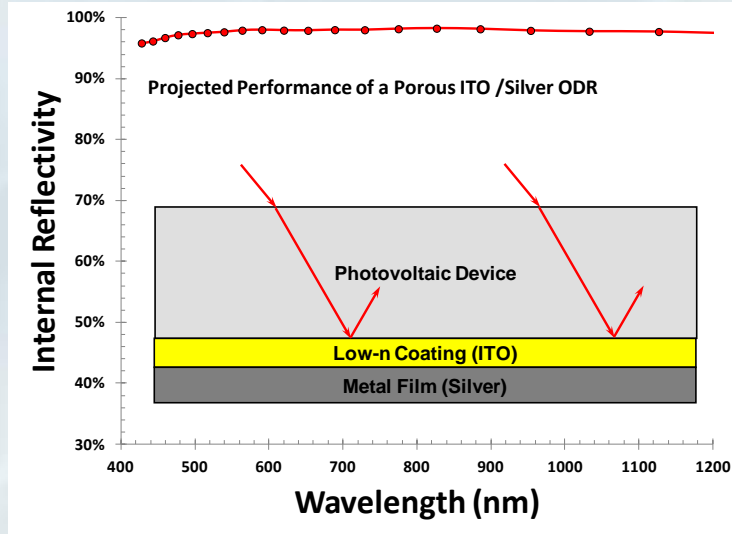


# Patent Pending Technology

## Conductive Omni-Directional Reflector (ODR)



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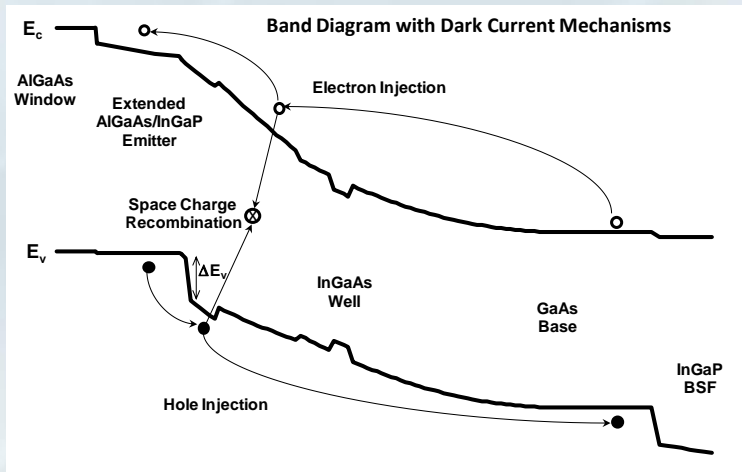
- **High performance ODR back reflectors** combine a low refractive index coating with a metal film below the PV device
- **Light harvesting** is enhanced by reflecting unabsorbed light back into the PV device
- **Peak** internal reflectivity can approach 100% over a wide range of angles (Omni-directional)
- **Conductive, low-n** transparent oxides such as indium tin oxide (ITO) have been demonstrated using an oblique angle deposition process
- **Nanostructured ITO films** can further enhance light harvesting via optical scattering mechanisms

# Patent Pending Technology

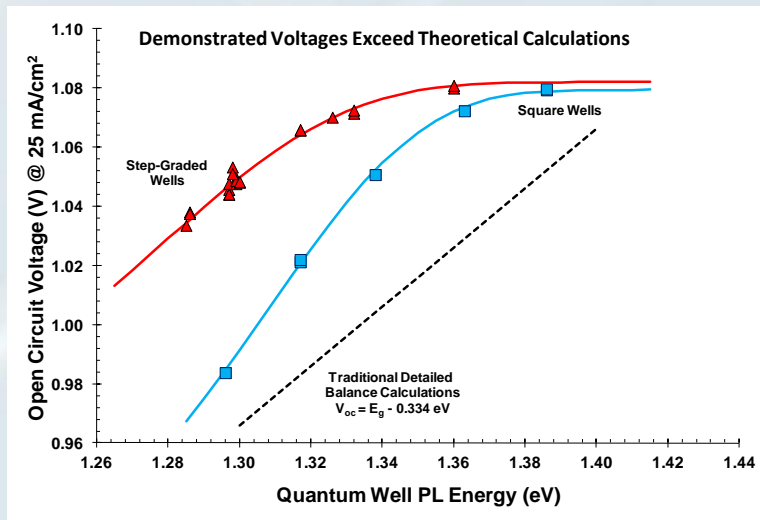
## High Voltage Quantum Well Solar Cell Structure



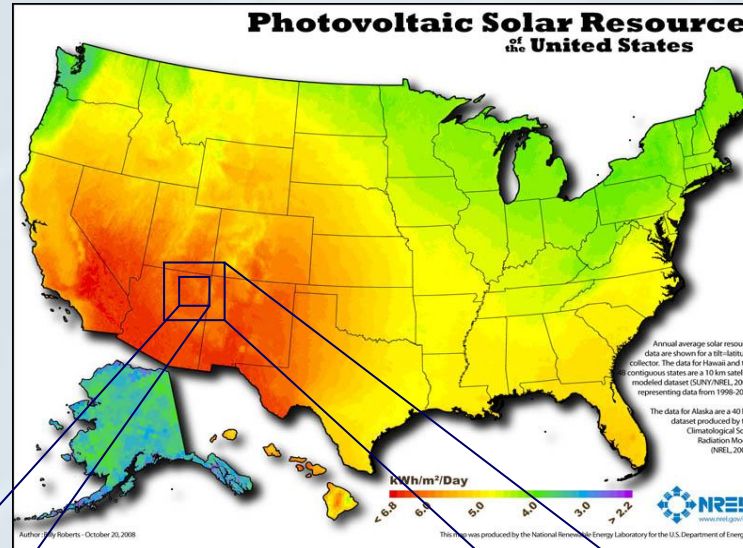
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- **Novel band-gap engineering** of the material structure minimizes unwanted recombination and enables photovoltaic devices to operate at higher voltages
- **Quantum-structured** active region harvests a wider range of the solar spectrum
- **New levels of performance** have been demonstrated and the operating voltage of Magnolia's quantum well solar cells shown to exceed traditional theoretical limits
- **Application of advanced light harvesting** structures provides a means to further increase both the current and voltage output, and hence the cell efficiency



# US Solar PV Land Requirement



## All US Electricity

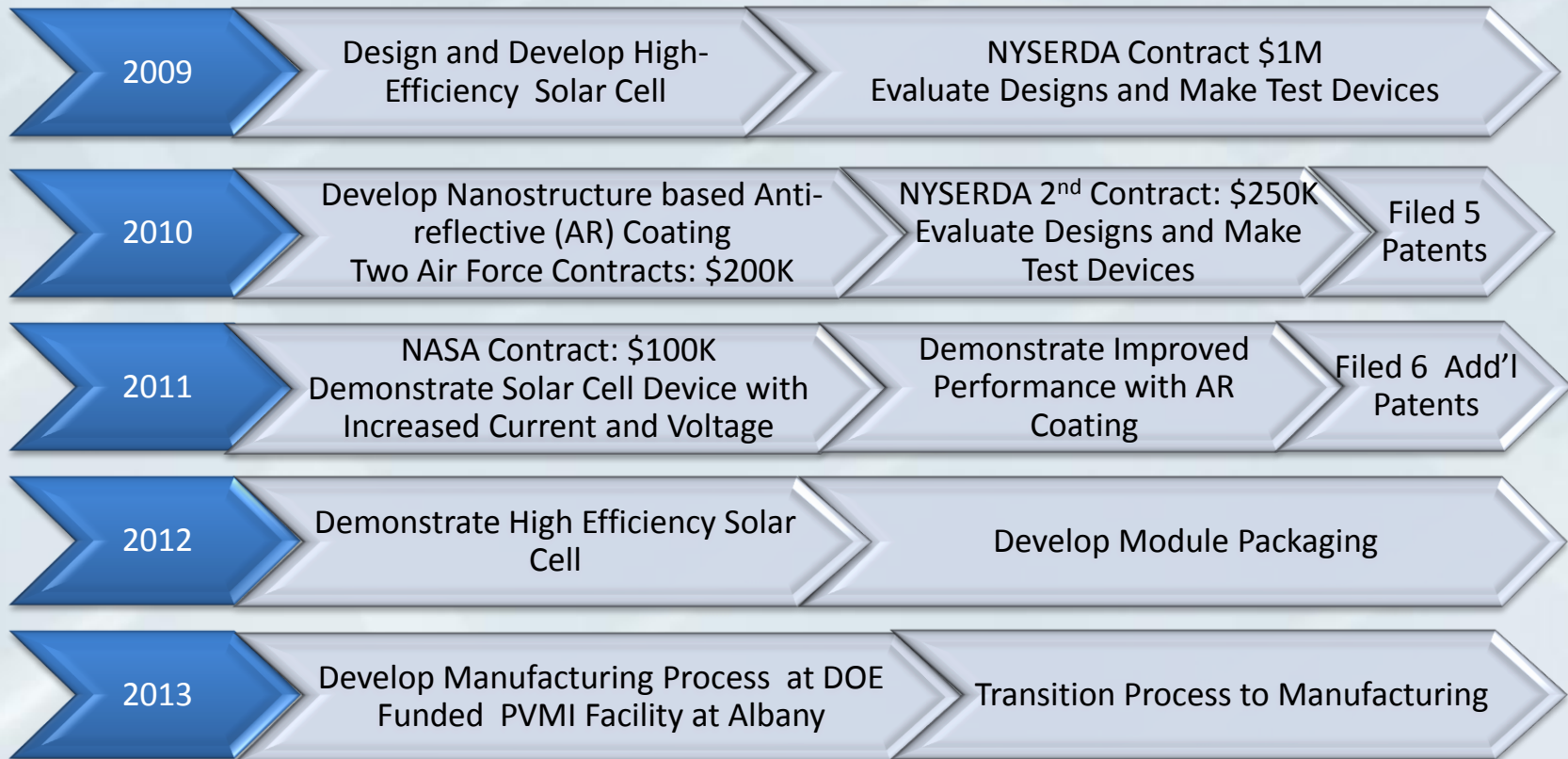
The solar energy resource in a 100 square mile area could supply the United States with all its electricity (approx. 800 GW) using modestly efficient (10%) commercial PV modules. **If PV module efficiency is tripled, one-third of the area is required.**

## All US Primary Energy

4.1 TW w/ 10% modules

**Solar PV is the only renewable energy source capable of supplying ALL of our electricity needs!**

# Milestones: Completed and Future



# Senior Management



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## **Dr. Ashok K. Sood – President & CEO**

- Over 30 years of experience with solar cells and optical devices for defense and space applications
- Managed technology, programs and product lines for Honeywell, Loral, Lockheed-Martin and BAE Systems
- Managed CdTe, CdS, and HgCdTe products, night vision system product line, ZnO and nanostructure programs from Defense Advanced Research Projects Agency (DARPA)
- Ribbon silicon solar cell development for Mobil-Tyco Solar Energy Corp (now Schott Solar); CdS, CdTe and GaN solar cell technologies
- B.S. and M.S from University of Delhi, India, and M.S. and Ph.D. from University of Pennsylvania

## **Dr. Yash R. Puri - Executive VP and CFO**

- Over a decade of experience in managing growing technology companies
- Previously Vice President, Finance, GT Equipment Technologies, Inc., now a public company (GT Solar, Inc. Nasdaq: SOLR) after \$500M IPO in July 2008
- Professor of Finance, University of Massachusetts, Lowell
- Developed financial models for solar photovoltaic applications
- B.S, M.S. and M.B.A from University of Delhi, India, and M.B.A and D.B.A in International Finance from Indiana University

# Management/Technical Team



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## **Dr. Roger E. Welsler – Chief Technical Officer**

- Expertise in materials, devices, and high-efficiency solar cells
- Funded by NASA, NSF, and DoD for solar cell development
- Previously, Director of Advanced Technology at Kopin Corporation
- Ph.D. from Yale University and B.S. from Swarthmore College

## **Mr. E. James Egerton – Executive Vice President of Product Development**

- Expertise in product development and technology management
- Previously managed and led product development at Lockheed-Martin, Honeywell, IBM and several start-ups
- B.S. from Evergreen State College, Graduate courses at Stanford, Masters from Harvard University, Postgraduate Diploma in Entrepreneurship from University of Cambridge

## **Dr. Gopal Pethuraja – Senior Scientist**

- Senior scientist with several years experience in energy nano-materials research
- Previously at Technion in Haifa, Israel and RPI, New York
- Ph.D. from Indian Institute of Technology (IIT), India

# Advisory Board Members



## **Dr. Tom Surek**

- Nearly 40-year career in photovoltaics
- Pioneer on shaped crystal growth of silicon
- Led R&D activities in thin film photovoltaics for the DOE.
- Achieved world-record efficiencies in crystalline silicon, thin-film, and concentrator solar cells

## **Professor E. Fred Schubert**

- Expert in optoelectronic devices and nanostructure-based antireflection coating technology
- Wellfleet Senior Constellation Professor of Physics at Rensselaer Polytechnic Institute
- Inventor/co-inventor of 28 U.S. patents and author/co-author of > 250 publications

## **Professor Zhong L. Wang**

- Expert in nanostructure growth and characterization of semiconductor materials and devices
- Professor and director, at the Center for Nanostructure Characterization at Georgia Tech
- Performed pioneering work in nanogenerators for energy harvesting
- Inventor/co-inventor of many U.S. patents and author/co-author of > 650 publications