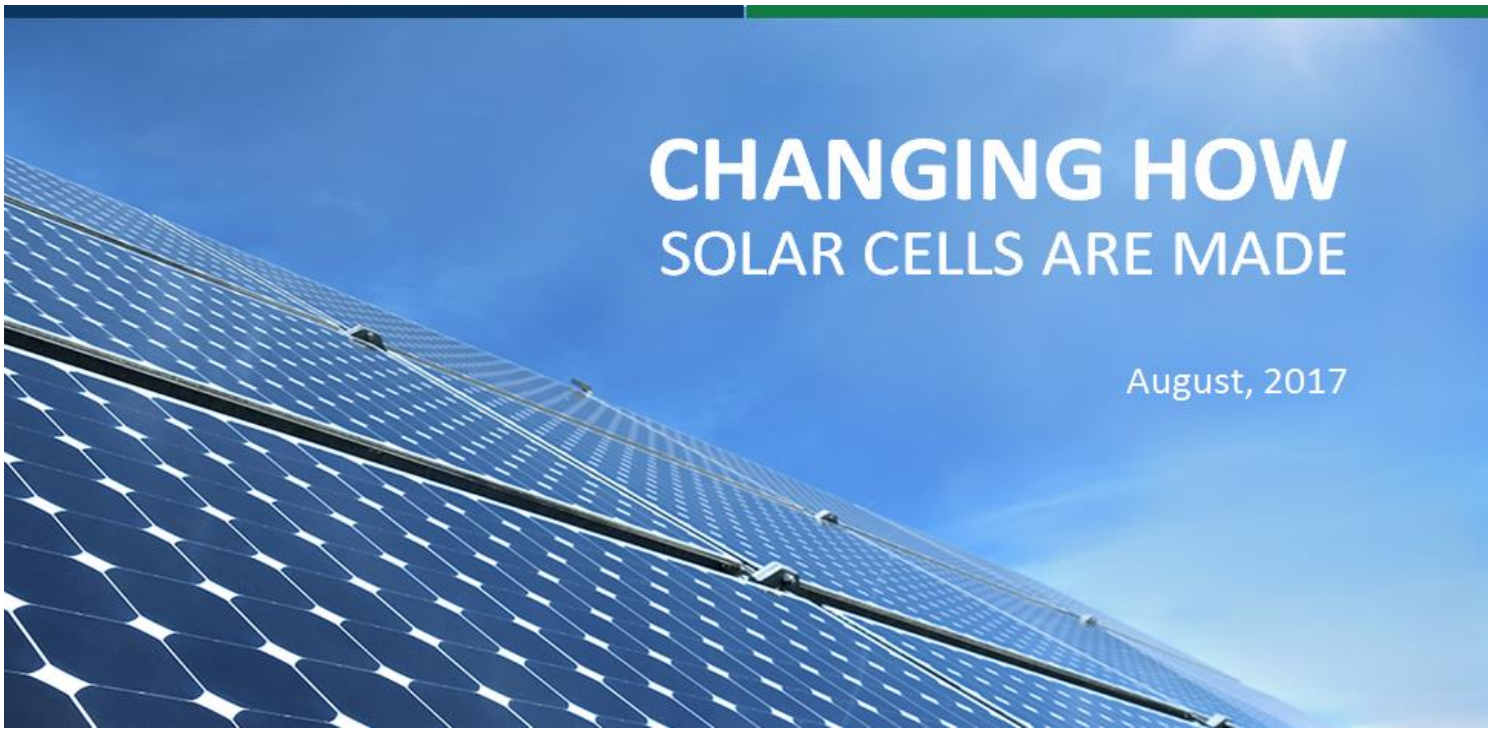
natcoretechnology
advancing solar science



NATCORE RESEARCH AND DEVELOPMENT CENTER

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Executive Summary

Overview and Vision

Natcore is a research and development company pioneering solar cells with improved efficiency and reduced cost. By combining world class expertise in the solar community with a well-equipped research facility, we are developing approaches that will define the next generation of cells. Our output is technology: we currently have 65 patents granted and pending. Natcore plans to move our technologies into manufacturing through partnerships that ultimately yield licensing and royalty revenue streams.

Primary Technology: Natcore Foil Cell (Laser Processed)

The vast majority of solar cells produced today employ front contacts—one of the cell's electrical contacts is the familiar grid of metal lines on the front of a cell. Even though the grid lines are thin, they block light and thus reduce efficiency. These standard solar cells are also made with a thermally diffused emitter, requiring very high process temperatures (>800C). The combination of front contacts and thermally diffused emitters limit current cell efficiency to about 19%.

Recently, a 25.6% efficiency was reported – the highest efficiency ever reached for a silicon solar cell. The cell in question used only back contacts, thus blocking no light. It also used a silicon heterojunction (SHJ) emitter, eliminating high temperature diffusion steps. While the achievement showed the value of these approaches, the cell was produced using a complicated, high cost process. The goal then: produce a cell like that at low cost.

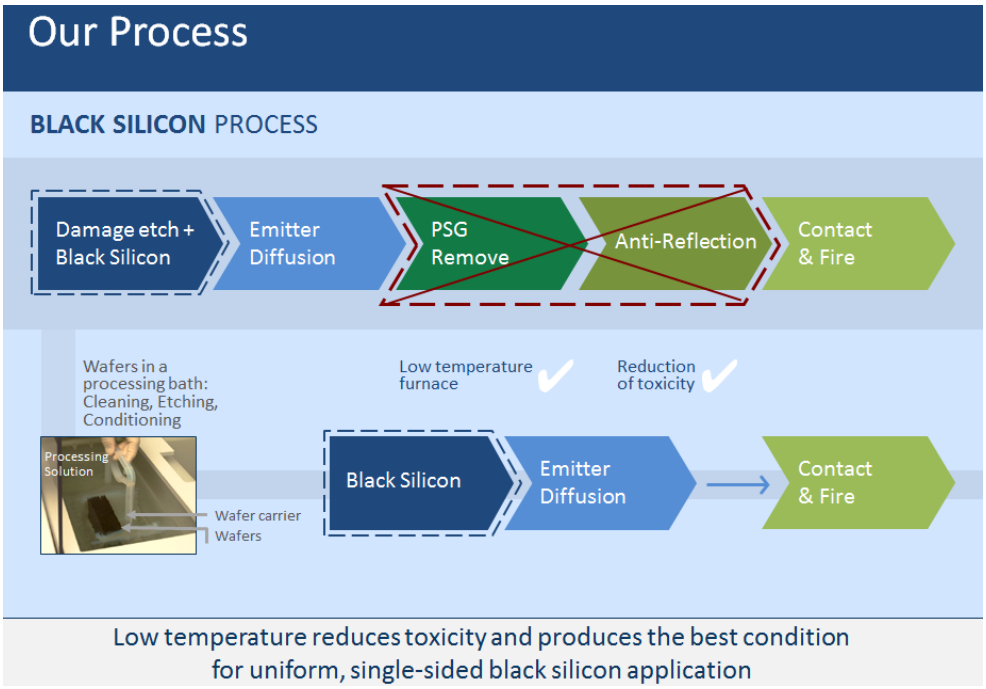
The Natcore Cell leverages laser processing and a revolutionary approach to contacting/metallizing the cell in order drive out cost while getting to high efficiency.

Our design requires highly defined regions of heavily doped silicon in order to form the base contact of the solar cell. By using a powerful focused laser beam, small regions of the silicon surface can be melted in the presence of a specially applied dopant, allowing that dopant to penetrate the silicon matrix. In particular, Natcore scientists have discovered a method to laser-form these dopant regions while not disrupting the high quality emitter already present on the solar cell. The laser process is rapid, and can be performed in low capital equipment at atmospheric conditions.

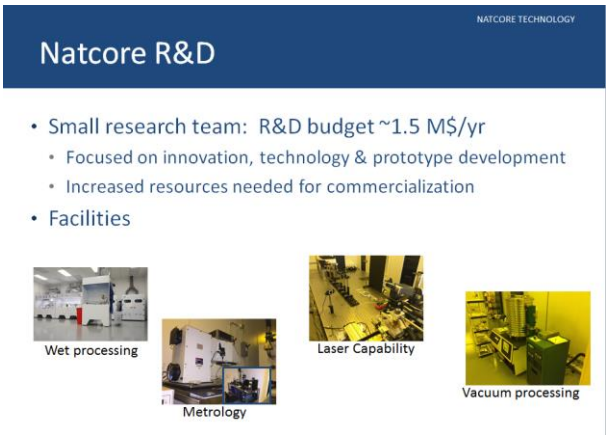
Our approach to metallization is game changing. Silver is a staple of current solar cells, being used for its high conductivity and easy processing. However, it can represent from 30 to 50% of the fabrication cost of a solar cell. Our unique metallization approach relies upon a simple multilayer structure composed of aluminum foils. The use of aluminum alone permits great cost saving. However, there are two additional areas of cost saving with our approach. First of all, the metallization process, leveraging the worldwide volume of aluminum foil production, can have a very low capital cost and footprint. Secondly, the resulting cell architecture is ideal for subsequent incorporation into modules cheaply and with low cell-to-module (CTM) losses.

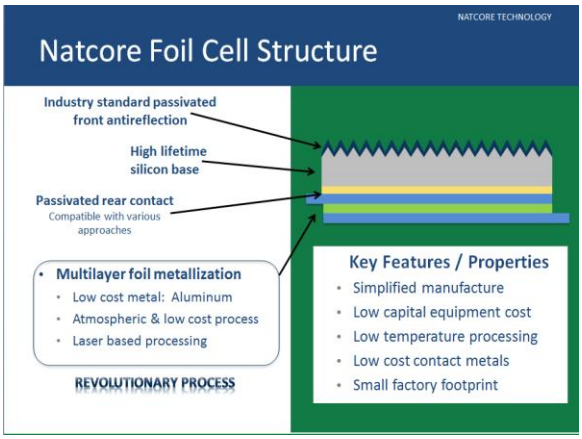

NATCORE TECHNOLOGY
BLACK SILICON
TECHNOLOGY

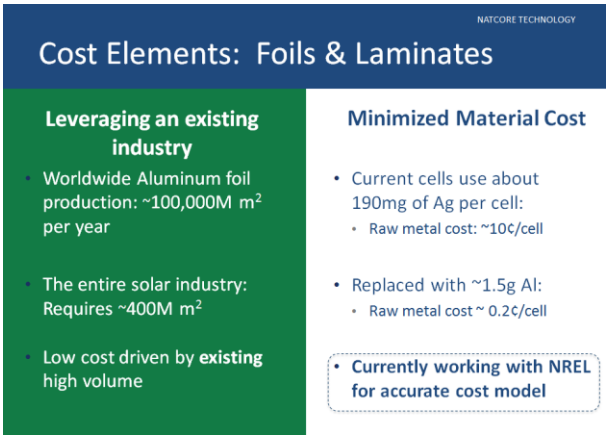

STANDARD PROCESS
Damage etch + Texture
Emitter Diffusion
PSG Remove
Anti-Reflection
Contact & Fire

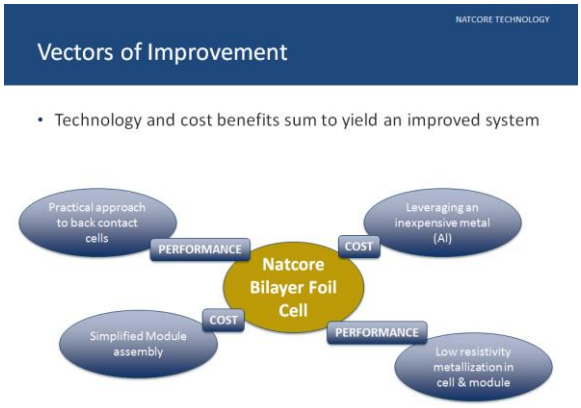

Our Process
BLACK SILICON PROCESS
Damage etch + Black Silicon
Emitter Diffusion
PSG Remove
Anti-Reflection
Contact & Fire
Wafers in a processing bath: Cleaning, Etching, Conditioning
Low temperature furnace
Reduction of toxicity
Processing Solution
Wafer carrier
Wafers
Black Silicon
Emitter Diffusion
Contact & Fire
Low temperature reduces toxicity and produces the best condition for uniform, single-sided black silicon application

Natcore has specifically protected its laser back contacted cell approach with a number of patent filings covering the architecture, laser process, and general processing characteristics. Natcore's rapid progress in this area is enabled by David Carlson and Charlie Gay, members of our Science Advisory Board. Both bring a recognized, extensive career in solar technology and business to the table.





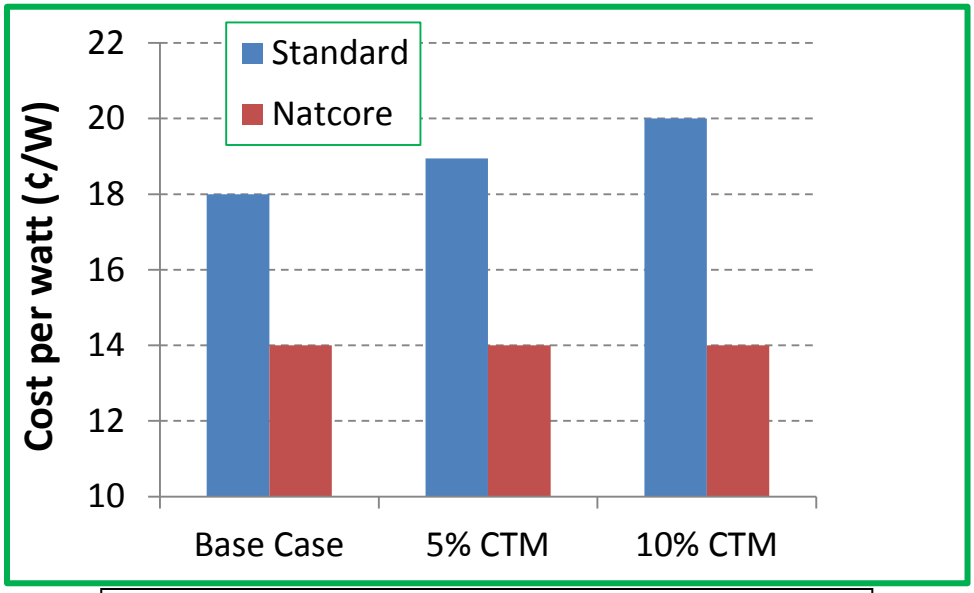




Natcore Target Cell Cost per Watt

We had a large manufacturer that asked us what our target costs per watt for individual cells would be. Below are Natcore's answers I hope you find of interest.

- The cost of a HIT cell is 40.1 cents per watt, by eliminating the metallization and reducing steps, we feel our target costs for a HIT cell will be 14 cents per watt.
- The cost of a standard cell currently is 18 cents per watt (17-19% efficiency), which means we are delivering a high efficiency back contact HIT cell (24-25% efficiency) for 14 cents per watt; 4 cents cheaper than standard cells.
- The cell to module (CTM) energy loss is anywhere from 5-10%. Assuming the lower range of 5% that effectively increases the cost of the standard cell to 17.85 cents per watt. Our cells will have zero (low to no) CTM, which keeps our costs at $8.74 cents per watt. If you take the upper range of 10% CTM that would effectively raise the cost of the standard cell to 18.7 cents per watt.



Effects of CTM: The cost benefit of the Natcore cell grows as CTM is considered. CTM is larger for standard cells.

Natcore's technology adds a component of simplicity that takes these high efficiency cells, reduces the cost dramatically and makes them viable to the industry

Foil Cell
(All Back Contact Solar Cell)

Natcore's Foil Cell uses high-speed, low temperature laser process

INCREASE efficiency

Black Silicon

Natcore's black silicon technology streamlines the path to low solar cell reflectance

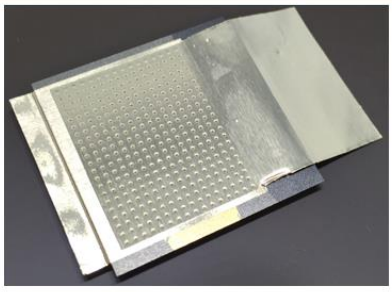
REDUCE costs

A Versatile, Customizable System

Traditional silicon hetero-junction cells hold the record for efficiency, **but high costs make them impractical**

NATCORE TECHNOLOGY

Industry Standard: Current vs. New Natcore Foil Cell ™



Current Standard Contact Cells

- Mature Technology
- Less Efficient
- Less Power Output
- Higher Silver Usage

New Natcore Foil Cell

- Low Cost Back Contact Cell
- Increasing Cell Efficiency up to 25%
- Reduced/Eliminated Cell To Module Energy Loss
  - Equates to 10% Increase Power Output
- Elimination of Silver

→ **will disrupt the industry**