Fabricating High-Power Solar Cells with a Novel Boron Emitter (#7991)

A simplified, cost-saving method for producing n-type commercial solar cells

This technology is a novel fabrication process that offers a cost-effective means of building innovative, high-efficiency solar cells. Specifically, this process improves the development of *n*-type solar cells, or those that include phosphorous in their silicon (Si) construction to support the flow of electric current. The fabrication method developed by Georgia Tech researchers includes a novel selective boron emitter for commercial *n*-type Czochralski (Cz) solar cells that facilitate an efficiency greater than 24%, demonstrating the potential of this technology to compete in the next generation of industrial solar cells.

The two-step selective boron emitter is achieved by a combination of ion implantation and atmospheric pressure chemical vapor to fabricate *n*-type Cz front junction Si solar cells with screen-printed contacts on the front and tunnel oxide passivated contact (TOPCon) on the rear. This innovation also enhances the TOPCon component of the solar cell by reducing its recombination velocities, thereby improving the overall efficiency of the cell. Higher efficiency solar cells reduce the surface area requirement for their installation and also save costs on their production and use overall.

Benefits/Advantages

- **Efficient**: Demonstrates a competitive level of efficiency road map of over 24.2%
- **Cost-effective**: Offers a simplified approach for fabricating TOPCon solar cells while still maintaining their efficiency
- **Sustainable**: Improves upon current renewable energy solutions that provide alternatives to fossil fuel–based energy consumption

Potential Commercial Applications

Solar cells have a wide range of applications for commercial and residential energy production. Some examples of their use in these settings are:

- General electricity
- Fans
- Batteries and chargers
- Water heaters

Background/Context for This Invention

Growth in the solar energy market is driven by the increasing environmental concerns for greenhouse gas emissions and consumption of fossil fuels. Though *n*-type solar cells are more reliable and generate higher levels of power, they are limited by high surface recombination velocities. Georgia Tech's novel selective boron emitter improves upon the TOPCon solar cell, taking advantage of its manufacturing process that is already more simplified and less costly than other types of solar cells. This new fabrication method further enhances the TOPCon cell's efficiency while keeping overall production costs low.

Ajay D. Upadhyaya
Senior Research Engineer - Georgia Tech School of Electrical and Computer Engineering

Keeya Madani
Former Graduate Student - Georgia Tech School of Electrical and Computer Engineering

Young Woo Ok
Senior Research Engineer - Georgia Tech School of Electrical and Computer Engineering

Dr. Ajeet Rohatgi
Regents Professor – Georgia Tech School of Electrical and Computer Engineering

Brian Rounsaville
Research Engineer – Georgia Tech School of Electrical and Computer Engineering

Vijaykumar D. Upadhyaya
Research Engineer I - Georgia Tech School of Electrical and Computer Engineering

More Information

U.S. Number: 62/725,284

U.S. Number: 62/891,591

Publications

Boron Selective Emitter formation with un-metallized J0e of 13fA/cm2 for Silicon Solar Cell Applications
, 47th PVSC IEEE, Oral Presentation, 2020, June 15, 2020

For more information about this technology, please visit:
https://licensing.research.gatech.edu/technology/fabricating-high-power-solar-cells-novel-boron-emitter

Images:

The automated sequential delivery of multiple fluids. A varying number of delay gates imprinted in the branches are shown in the figure.

COVID-19 and flu saliva test on paper: (A) The automatic sequential delivery of multiple reagents required for virus test; (B) Water pouring into the device triggers the virus assay, allowing the presence of SARS-CoV-2 and influenza A & B viruses to be visually identified by the color changes in the corresponding detection spot