September 25, 2009

Suntech, Sunovia, IMEC, Q-Cells, Fraunhofer & Oerlikon Hit World PV Efficiency Records

Hamburg, Germany [RenewableEnergyWorld.com & Photovoltaics World]

Making solar cells and modules as efficient at converting light to electricity as possible has been a long-standing goal in the solar photovoltaic space. Much progress has been made in the past few years, but this week world-record breaking efficiencies were reached by Suntech (multi-crystalline silicon modules), Sunovia (single-junction and two junction CdTe cells), IMEC (GaAs/Ge multijunction cell), Q-Cells (polycrystalline silicon cells), Fraunhofer (n-type silicon cells) and Oerlikon (amorphous silicon single-junction cells).

> Meanwhile, Oerlikon Solar announced that it has achieved a new stabilized record efficiency level for amorphous silicon (a-Si) single junction PV cells.

Suntech Power Holdings Co. Ltd. announced that it has beaten all previous records, including its own, for multi-crystalline silicon module conversion efficiency. The new world-record conversion efficiency (aperture area only) was measured at 16.53% by the Fraunhofer Institute for Solar Energy Systems.

Suntech's world-record breaking multi-crystalline silicon module is powered by Pluto PV cells utilizing solar grade silicon with each PV cell having a conversion efficiency well over 17%.

In August, Suntech surpassed the previous record of 15.5% set by Sandia National Labs 15 years ago. The latest record is well above previous records and is a reaffirmation that Suntech's Pluto powered multi-crystalline modules have the highest conversion efficiency in the world.

"We are very pleased to announce that our Pluto technology has been recognized as the most efficient multi-crystalline silicon technology in the world," said Dr. Stuart Wenham, Suntech's CTO. "This shows that it is possible to combine both first class R&D and low cost manufacturing into a commercially viable business model that will bring clean alternative energy to the world's growing energy demands."

Sunovia Energy Technologies Inc and EPIR Technologies, said that they have fabricated single-junction and two-junction cadmium telluride (CdTe) based solar cells that have far surpassed the long-standing world record open circuit voltage (Voc) for thin-film CdTe solar cells.

The companies' single-junction and two-junction devices exceeded the highest Voc values ever reported publicly by research institutions on thin film CdTe solar cells, including the National Renewable Energy Laboratory (NREL) and others, by over 45%.

They called the Voc breakthroughs significant because the amount of electric power generated by a solar cell is directly proportional to its open circuit voltage. So doubling the Voc of a solar cell results in a doubling of power output, if all other characteristics remain the same.

The results reported by the companies will enable the companies to create solar cells with much higher efficiencies than other CdTe-based solar cell technologies.

IMEC researchers presented a Gallium Arsenide/Germanium (GaAs/Ge) multijunction cell demo with potential >40% efficiency. First, the group described what it calls a demonstrator of mechanically stacked, high-efficiency InGaP/GaAs/Ge triple-junction solar cells. This multijunction cell starts with a one-side contacted GaAs top cell (4µm thick) transparent for infrared light, by itself 23.4% efficient (close to that of standard GaAs cells).

Improved Efficiencies in Solar PV

This cell is then transferred onto a Ge bottom cell creating a mechanical stack; the separately-contacted Ge bottom cell has a 3%-3.5% efficiency, higher than Ge bottom cells in leading monolithically stacked InGaP/InGaAs/Ge cells, the researchers note. The goal is to have a working triple-junction cell in early 2010.

Expected conversion efficiencies of the whole thing are expected to be 1%-2% higher than what is obtainable today with monolithic triple-junction solar cells, or >40% using concentrated illumination. The new cells also show what IMEC calls "enhanced spectral robustness;" stacked solar cells made from different materials have been proven to capture and convert more of the light spectrum than just one material.

Q-Cells AG says it has reached 15.9% conversion efficiency (certified by the Fraunhofer ISE) for its polycrystalline silicon solar cells, a world record for mass-production using "common industrial standards." The 249W module built with the cells was made on Q-Cells' €50M "Technikum" pilot line in Thalheim.

The new cells based on a "new-generation" poly-Si produced in the company's production lines have shown up to 17% efficiency, and are targeted for launch sometime in 2010. However, this is "only the beginning," assured company chairman Anton Milner, in a statement, noting that the new mark shows the competitive prowess of both the company and Germany as a whole — "especially compared to more commoditized producers using standard technologies in low-cost countries."

Researchers at the Fraunhofer Institute for Solar Energy Systems (ISE) have developed prototype n-type silicon solar cells with conversion efficiency exceeding a record 23.4%.

P-type silicon solar cells are the most common ones today, but n-type cells offer better PV electricity production thanks to properties like greater impurity tolerance, and it does not suffer from light-induced degradation as does p-type Cz silicon. The end result is better efficiency or lowered manufacturing costs using less-expensive silicon, notes Martin Hermle, Fraunhofer ISE's group manager, in a statement.

P-type solar cells have a p-type base and thin n-conductive layer; in n-type solar cells the emitter is p-doped through boron diffusion or added Al. Among key problems in using n-type silicon as a base solar cell material is that the sun-facing emitter's passivation, doped with boron, can't be optimally passivated with conventional layers such as SiO_2 or SiNx. Working with the Technical University of Eindhoven, Fraunhofer says it has solved front passivation by using aluminum oxide (Al_2O_3).
A 2×2cm² n-type cell was shown to achieve 23.4% conversion efficiency; a bigger cell (12.5×12.5cm², "using much simpler process stages close to industry practice" — including a screen-printing application of the aluminum alloy emitter — reached 18.2% efficiency. The researchers say they will further tweak the process technology to push the commercially-viable silicon solar cells to exceed 20% efficiency rates.

Meanwhile, Oerlikon Solar announced that it has achieved a new stabilized record efficiency level for amorphous silicon (a-Si) single junction PV cells. Recent test results reconfirmed and approved by the NREL show efficiencies of more than 10 percent power conversion.

These results set a new world record for amorphous thin-film silicon PV technology. The R&D group of Oerlikon Solar in Neuchâtel was able to consistently reproduce cells with similar record efficiencies, demonstrating a stable and repeatable process. The recent success on a-Si cell efficiency serves as basis to achieve Micromorph production modules at stabilized efficiencies of 10% or more.