

Photovoltaic Carnival in Taiwan

Highlights on PV Taiwan 2009 held on 7 - 9 October 2009

Abstract

PV Taiwan 2009 is a photovoltaic carnival for the domestic and international PV players. The exhibitors joined this event and the booth used for the exhibition increase by 52% and 67% respectively over the previous year. Combining a forum and exhibition, PV Taiwan 2009 provides a one-stop sourcing platform for global PV industry players to catch the latest trends and markets, order high-quality PV products and link business partners and agents. Also, it provides good opportunity for over 8000 visitors to learn the progress of global and domestic PV industry and get educated on the latest technologies and products in the PV industry.

PV (photovoltaic) Taiwan 2009 forum and exhibition held on 7 - 9 October 2009 at Taipei World Trade Center (TWTC) is an international PV carnival (see fig. 1) gathering domestic and international manufacturers under one roof to showcase the latest PV technologies including PV materials, silicon wafers/ingots, Solar cells, PV modules, HCPV, BIPV, power generator systems, application products, processing equipment, testing and analysis devices, and certification services. 77% of exhibitors are from Taiwan PV industry that supplies the world market with 12% of solar cells (ranked fourth in global volume production). This event was organized by TAITRA (Taiwan External Trade Development Council) and SEMI. After the success of Taiwan PV Forum 2006, this is the 4th year for the forum and 3rd year for the exhibition. This forum and exhibition attracted 236 leading companies from global PV industry participating with 500 booths to demonstrate the latest PV technologies and bring together the elite of Taiwan industry. PV Taiwan 2009 has increased the number of exhibitors by 52 % and booths by 67% over the previous year (see Table 1). Meanwhile, the number of visitors attracted to this great event has also increased from 6000 to over 8000. In spite of the gloominess in early 2009 due to the global economic recession, the Taiwan government just successfully passed the Renewable Energy Act in June 2009 that brings Taiwan to a new era of alternative energy development and related applications. The currently-approved plan is backed by a five-year budget of NT\$20 billion (equal to US\$0.62 billion), which is specifically dedicated toward investment in R&D green energy technologies, and is expected to generate NT\$200 billion (equal to US\$6.2 billion) in private investments for the industry.

Well-known domestic PV firms including Gintech, Neo Solar, SAS, Auria Solar, Sun Well, Chi Mei Energy, Mosel, Ritek, Gloria Solar, PCM, Kinmac Solar, Sunner, Sintek, Solartech, Big Sun Energy, Everphoton and others attended the exhibition to introduce their latest and highly competitive products and attracted domestic and international buyers. For example, SINTEK Photronic Corp. exhibited a prototyped heat insulation BIPV solar module by inserting a thin transparent heat



insulation layer, Sun Well Solar showcased their semi-transparent a-Si thin film PV modules by special processing on the reflector layer, Big Sun effectively improved the Combo-Cell conversion efficiency up to 17.8% for the 6" and 5" Mono cells by utilizing special shallow junction, highly anti-reflective surface texturing processes as well as incorporating an optimal electrode layout, and Gintech Energy Corp. has developed a colorful phoenix series of 6" multicrystalline Si solar cells for the BIPV applications. In addition, 54 overseas leading companies came to shine the PV Taiwan 2009, such as DuPont from the United States, NISSHINBO from Japan, ISOVOLTA AG from Austria, JONAS & REDMANN from Germany, CRITICAL MANUFACTURING SA from Portugal, SVCS PROCESS INNOVATION from Czech Republic, ASYS Group from Singapore, PARU from Korea, LDK Solar from China and others. These overseas leading players exhibited their innovative products such as Dupont's Kapton polyimide thin film substrates which can deliver robust processing for CIGS and a-Si flexible thin film solar cells and Siemens' SIMATIC tracking system without solar sensors using the astronomy mechanism and having a theoretical angle tolerance to be as small as one tenth of the prevailing standard. Thanks to the government subsidization programs of supporting the use of solar energy in US and many European nations, the PV module market for Taiwan manufacturers is primarily in US and Europe.

This year PV Taiwan 2009 launched the HCPV (high-concentrated photovoltaic) Pavilion that combines product displays, international forums and technology presentations providing an ideal marketing platform for global HCPV players. The primary reason for using HCPV technology is able to use less solar cell material in a PV system, to enhance the performance of the PV module as well as to reduce cost of energy production. It shows great market potential and will become the new focus of Taiwan PV industry. 13 key players including Everphoton, Compound Solar, Arima, and Bergquist joined this unique pavilion. Everphoton displayed their High Efficiency Mobile Solar Power Supply which can supply 7kWh electricity power every day with the effective efficiency up to 25%, featuring zero pollution, noise free operations to commercial, industrial and even emergency applications.

Although the first generation of Si-wafer based solar cells occupies 85% of the PV market shares, thin-film solar cells as the second generation of solar cells have been developing fast because it is low cost, flexible, and easy to manufacture. SA-100 from Sunner Solar Corp. is a single junction amorphous Si (a-Si) PV module, which is lower in efficiency compared with traditional Si-wafer based modules, but with characteristics of superior performance in weak light conditions which provides a true advantage and will generate 20% more electricity annually. It would be especially useful for the regions located at high latitude. CompSolar's CPV module with their III-V High Efficiency Solar Cell has already been installed at the roof top of the Taiwan Tianmu Sogo Shopping Mall, which highlights the application of HCPV technology in the city region where the land cost is high and makes traditional wafer-based modules less economical. CIGS solar module would be another new choice for the future PV industry because it has the highest performance among a-Si, CdTe and CIGS thin film solar cells. It can be



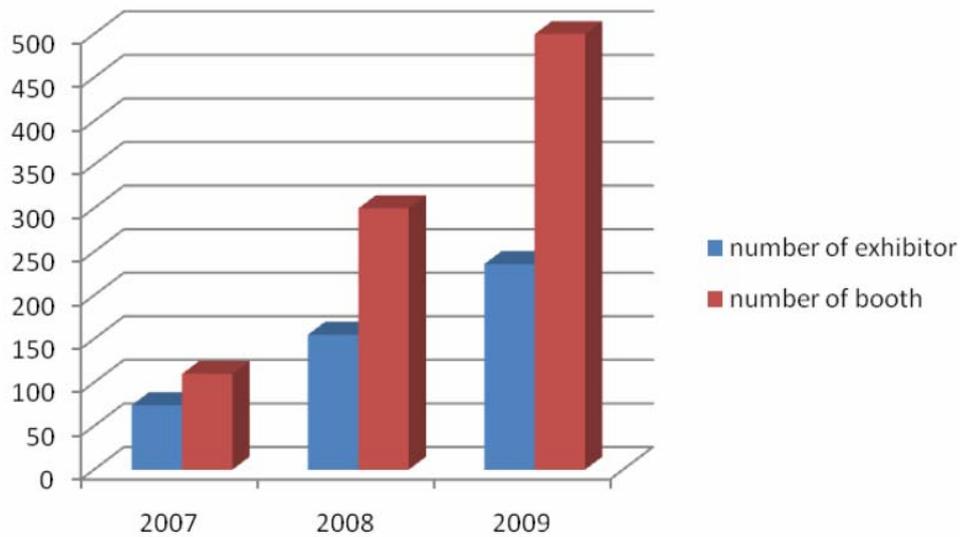
applied on flexible substrates and it has high throughput, and generates more power, suitable to BIPV applications. In PV Taiwan 2009 Exhibition, companies such as Ritek, Anji and JF New Energy showcased their new CIGS solar modules with the module efficiency of 12.06~14.17%, 10% and 9.2% (will be increased to 12% by 2010) respectively. All of them are planning to start mass production by the end of this year and their production capability is expected to reach around 30~40MW for the first year. The parameters for these three types of thin-film solar cells are listed in Table 2.

The first-ever PV Museum is another feature of PV Taiwan 2009 exhibition. It offers information on milestones and critical developments of solar energy and the complete PV production process. New and practical solar energy applications in the areas of food, clothing, housing and transportation are displayed, including solar cooking pots, solar rucksacks, solar pet houses, and solar cars. This PV Museum is a good place for visitors to learn the progress of global and domestic PV industry development and get educated on the technologies and products of related upstream, midstream and downstream businesses.

Along with this exhibition, the 4th PV Taiwan Forum was held on October 7-8 in TICC (Taipei International Convention Centre). This Forum invited 18 experts from the PV industries, government bodies, academic and research institutions to share their insights on the latest trends and updates in the PV industry through discussions on 4 topics: "Global PV Industry and the Market", "Polysilicon and New Materials", "New PV Applications and Technologies" and "Thin-film PV Technologies". Guest speakers are from Bureau of Energy, Solarbuzz, Morgan Stanley, MEMC, Elkem, LDK, Sino-American Silicon, DuPont, G24 Innovations, FUJIFILM Dimatix, Wuerth Solar, Applied Solar, ULAV, Oerlikon and others. Although no DSSC and OPV products are displayed in the PV Taiwan 2009 exhibition, development and applications of DSSC and OPV technologies are discussed in the "New PV Applications and Technologies" session. Last but not the least, nanotechnology has been incorporated into the new types of thin film solar cells for improving the performance and simplifying the manufacturing process. Nanotechnology-related products showing up in this exhibition include the SAS' nano-patterned sapphire substrate for improving LED's efficiency and FUJIFILM's inkjet printheads for nanoink printing (see Fig. 2).



Fig. 1. PV Taiwan 2009 Exhibition attracting 236 PV companies to use 500 booths



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Table 1. Comparison Table for the exhibitors and booths of PV Taiwan 2007, 2008 and 2009 exhibitions



	Amorphous	CdTe	CIGS
Source materials	Si	Te, Cd compounds	Cu, In, Ga, Sn compounds
Light absorption layer thickness	0.2~0.5 μm	1 μm	<1 μm
Light absorption efficiency	Indirect energy gap materials Photon absorption frequency is 1.1~1.7eV	Direct energy gap materials Photon absorption frequency is 1.02~1.68eV	Direct energy gap materials Photon absorption frequency is 1.45eV
Actual Module Conversion Efficiency	5~8%	8.5~10.5%	10~12%
Manufacturing Process	CVD or sputtering	Evaporating and other fast film deposition methods	sputtering
Pro and Con	<ul style="list-style-type: none"> • Si source material consumption is only 1/600th of that used in crystalline-based solar cells and thus the raw materials are enough • Poor stability with SWE • Tandem structure can improve it 	<ul style="list-style-type: none"> • Good stability, No SWE • Te and Cd raw materials is scarce and will face the source material shortage for the volume production • The toxicity of Te and Cd is still a big problem for the household applications, against the green technology principle 	<ul style="list-style-type: none"> • Good stability, No SWE • Sn and In raw materials is scarce and will face the source material shortage for the volume production • The toxicity of CdS buffer layer is still a big problem for the household applications, against the green technology principle

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Table 2. Comparison table for the amorphous-Si, CdTe and CIGS thin film solar cells



Fig. 2. Nanotechnology-related products showing up in PV Taiwan 2009 exhibition