Ingenious e-Brain

Nurturing Innovations - Fostering Business

Green Solution to Affordable Energy

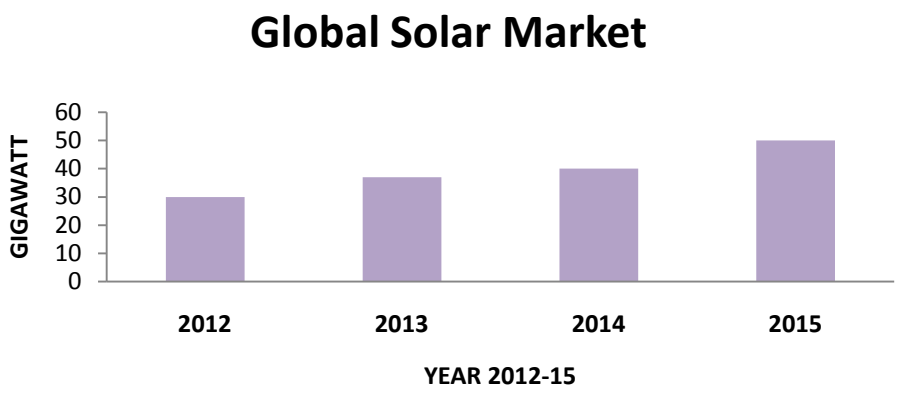
Author: Somoleena

July '2016

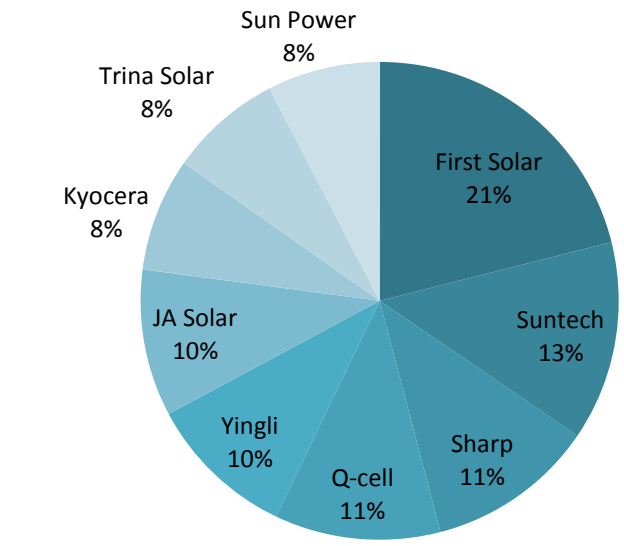
On the quest for renewable energy, solar cell technology emerged as an enduring icon. There are three main types of solar photovoltaic modules: first generation monocrystalline and polycrystalline; and second generation thin-film. Thin-film technology has proven to be the most commercially viable.Thin film technology is named so because a thin film panel is produced by deposition of thin, consecutive layer of molecules on a surface matterwith thicknesses ranging from fractions of a nanometer to several micrometers. Thin-film technology has always been cheaper than conventional crystalline silicon (c-Si) technology with wider industrial applications such as transportation, packaging, aerospace and defense, power backup, agriculture, medical devices and instrumentation.

Three film technologies often use for outdoor applications are cadmium telluride (CdTe), copper indium gallium selenide (CIGS) and amorphous silicon (a-Si). Amongst the three CIGS is commonly used by companies for thin-film production because silicon modules are expensive and cadmium is toxic in nature.

The most common method for production of CIGS is vacuum-based process wherein copper, indium, gallium and selenide are co-evaporated to form the structure and then deposited on a surface in a vacuum. However the catch is the high cost associated with the production.The cost of fabricating the product makes it difficult to be competitive with current grid prices.



***(Source:** Solarbusinesshub[1])*



***(Source:** Renewable Energy Blog [2])*

Nanocrystal as Green Solutions

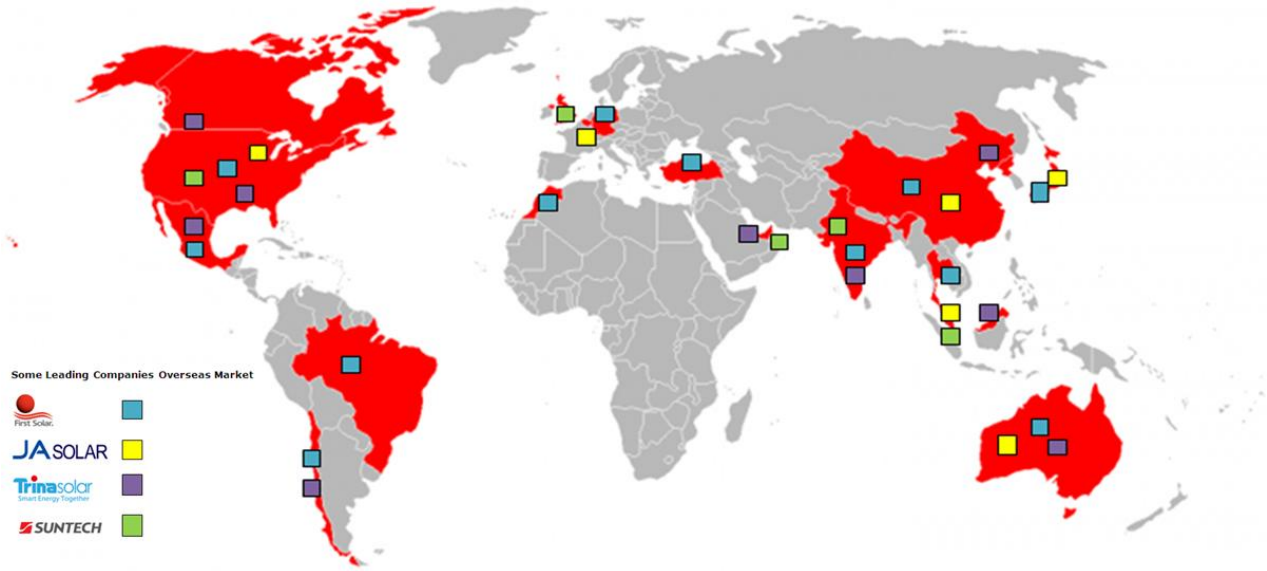
Researchers at Institut de Ciències Fotòniques (ICFO), Barcelona have developed a nanocrystalline photovoltaic material that can be solution processed at low temperature (below 100°C) and at ambient pressure. The material is based on non-toxicsilver bismuth sulphide ($AgBiS_2$) nanocrystals**[3].**

AgBiS2-based solar cells are promising alternatives to the conventional thin film based technology. Not only it is made up of non-toxic, earth-abundant elements, but also it is a very strong panchromatic absorber up to wavelengths of 1000 nm. It is also synthesized at very low temperatures (100ºC), an order of magnitude lower than the ones required for conventional silicon based solar cells**[4].**

The device has demonstrated certified power conversion efficiencies (PCEs) of 6.3% using only 35 nm thick light absorbing layers.Also the low-cost solution processing techniques without the need for the sophisticated and expensive equipment required to fabricate many othervacuum-based process solar cells**[3].**

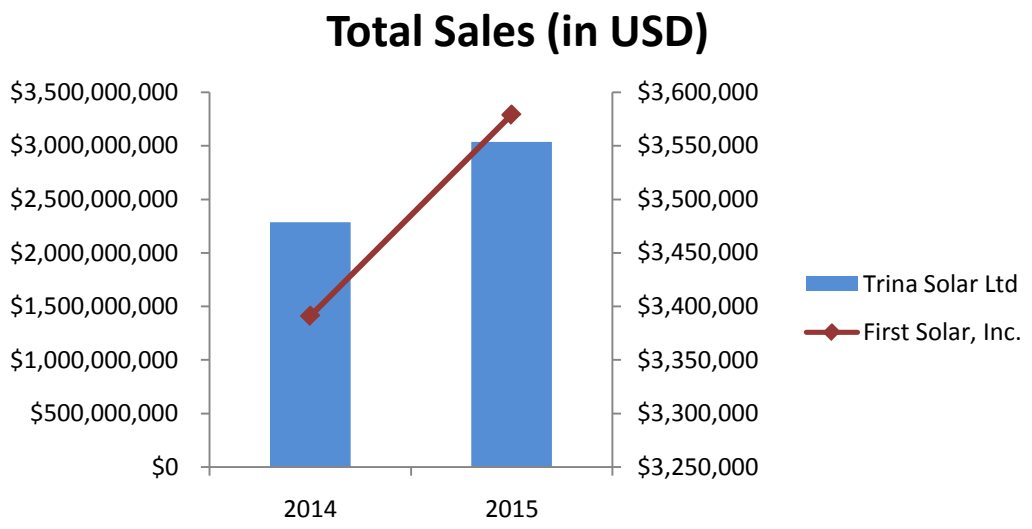
Market of thin-film technology

Momentum has been building in thin-film technology which holds a good share in solar photovoltaic industry. BCC projects this thin-film technology market to reach near $8.9 billion by 2016 and projected to reach nearly $18.8 billion by 2021 at a compound annual growth rate (CAGR) of 16.1%.Continuous technological advancements, and significant decline in production cost, are driving the increase in the use of renewable energy sources such as solar thin film batteries. Further the rise in energy cost coupled with stringent environmental policies is further driving adoption of this technology**[5].**



***(Source:** Annual Report and site of companies [6, 7, 8, 9])*

Trina Solar Limited a global leader in solar power modules, solutions and services operates in the People's Republic of China, Europe, the United States, and other Asia Pacific regions. It has filed over 1200 solar photovoltaic patents and 711 granted patents. It holds the record of highest Mono- and Multi-crystalline cell conversion efficiencies 22.13% and 21.25 %(P-type);23.5 %(N-type) respectively in the laboratory**[6].**



***(Source:** Annual Report(Trina and First Solar)*[6, 7]*)*

Another company First Solar, Inc. has recently invested $775 million in technology for boosting panel efficiency and produce panels for as little as 40 cents a watt, about 15 percent less than Trina Solar Ltd. First Solar uses a thin film semiconductor ofcadmium-telluride, reaching efficiency of 22.1% in a laboratory cell **[7].**

Summary

To summarize, it's very clear that thin film is significantly economical than conventional silicon cells and thin film is no longer at an efficiency disadvantage vis-à-vis silicon. Although solar technology was dominated by silicon, the thin-film technology is emerging fast and with the company like First Solar, producing panel for as low as 40 cents/watt, have become the top solar company in the world. With the emergence of technology like AgBiS2 and industrial collaboration, thin-film technology can bring electricity to areas in need of electricity and a safer & more sustainable world for the future.

Reference

[1]Solarbusinesshub (http://resources.solarbusinesshub.com/)

[2]Renewableenergyworld (http://blog.renewableenergyworld.com/)

[3]Science daily(https://www.sciencedaily.com/releases/2016/06/160620120352.htm)

[4]Bernechea et al (2016). Nature Photonics

[5] Bccresearch(http://www.bccresearch.com/)

[6] Trina Solar.-Annual Report

[7]First Solar, Inc**.** - Annual Reports

[8] JA Solar**.** – Official Site

[9] Suntech Power. – Official Site