Photovoltaic Activities in Nordic Countries

Jarmo Skarp
Arrivac
jarmo.skarp@arrivac.com

The growth of photovoltaic (PV) market has been fast, 30 – 40 % annually in the last few years. PV industry has become a remarkable sized industry with the turnover of about 6 B€ in 2006. – This revenue translates into an area of about 26 km2 of produced modules in one year alone.

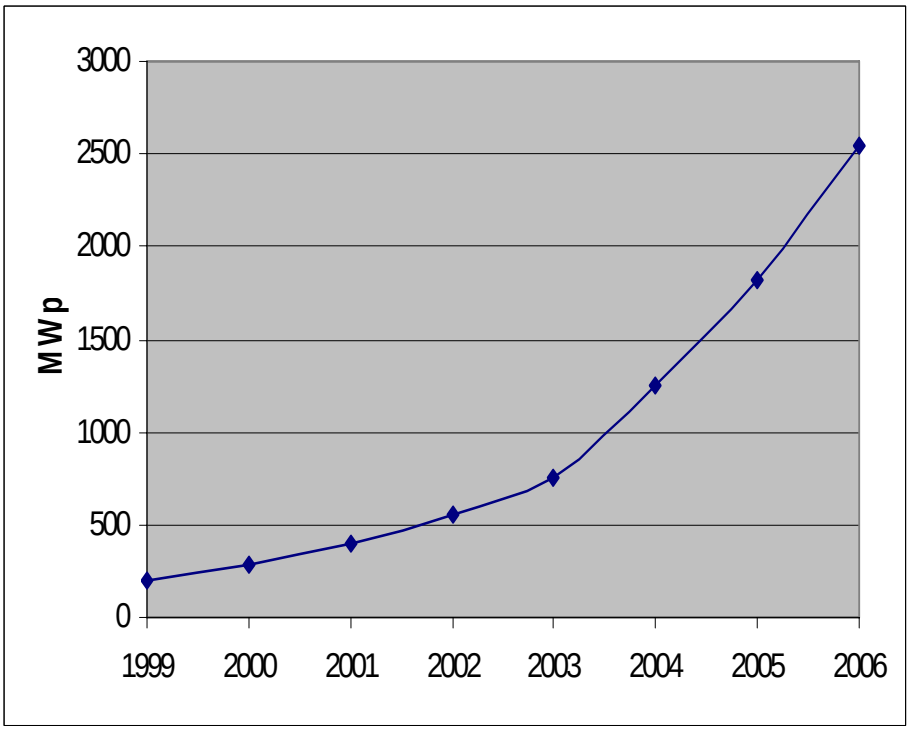

Fig 1. The yearly produced PV modules expressed in peak watts, Wp. Peak watt is the electrical power the cells produce under 1000 W/m2 standard illumination.

Photovoltaic devices can be divided in two groups based on the cell type: silicon wafer type cells and thin film solar cells. Different types of PV technologies and their future prospects are presented in details in Appendix 1.

Silicon PV-devices represent the older manufacturing technology and consist more than 90 % of all manufactured PV-devices. The thin film manufacturing is catching up, however, and it is forecasted that proportion of TFPV market share will reach 20 % by the year 2010. When the total market is also growing this is a huge task and business opportunity for both thin film deposition specialists and tool manufacturers.

Thin films are an integral part of all types of PV cells. Those are used as anti-reflective coatings or transparent or metallic electrodes also in the conventional silicon wafer technology, not to mention TFPV where the complete cell structure consists of pile of different thin film layers. There is at least one thin film layer in every PV-cell and therefore PV is one of the largest applications of thin film industry.

Nordic countries are very active in both manufacturing and research of various PV-technologies /2/.

Norwegian companies (REC, Elkem Solar, NorSun) have become large producers of intermediate products in solar cell manufacturing chain (metallurgical grade silicon, poly-silicon, single crystal ingots/multi-crystalline blocks, wafers, cells and modules)/3/.

Norway has a long (about 100 years) history in the manufacturing of metallurgical grade silicon which has made the threshold to enter Si-PV business remarkably lower. It was only ten years ago that the first cell manufacturing companies were founded. Today they are among the biggest PV companies in the world. The product scope is also wide: Norwegian companies cover each step in the silicon manufacturing chain from silica reduction to module manufacturing. This has given them a strong position in the market which has suffered of the shortage of poly-silicon (feed-stock for Si wafers).

Photovoltaic in Sweden is famous for its research in CuInGaSe2 (CIGS)thin film solar cells. The Ångström Solar Center in Uppsala University is a world class centre of thin film PV /4/. The work was started in 1982 in Stockholm but moved to Uppsala in 1994. Since then they have shown excellent results in efficiency. This technology is now entering in commercial production by Solibro GmbH.

Big (36 people) group of people are working in Tallinn Technical University (TTU) on PV. They have developed a new type of solar cell, so called mono-grain PV structure. Each monocrystalline grain (e.g. CIGS) is covered with n-type material to form small PV-cells. The grains are dispensed evenly on TCO with the help of epoxy and covered with back electrode to get a larger area cell, see Fig.2.

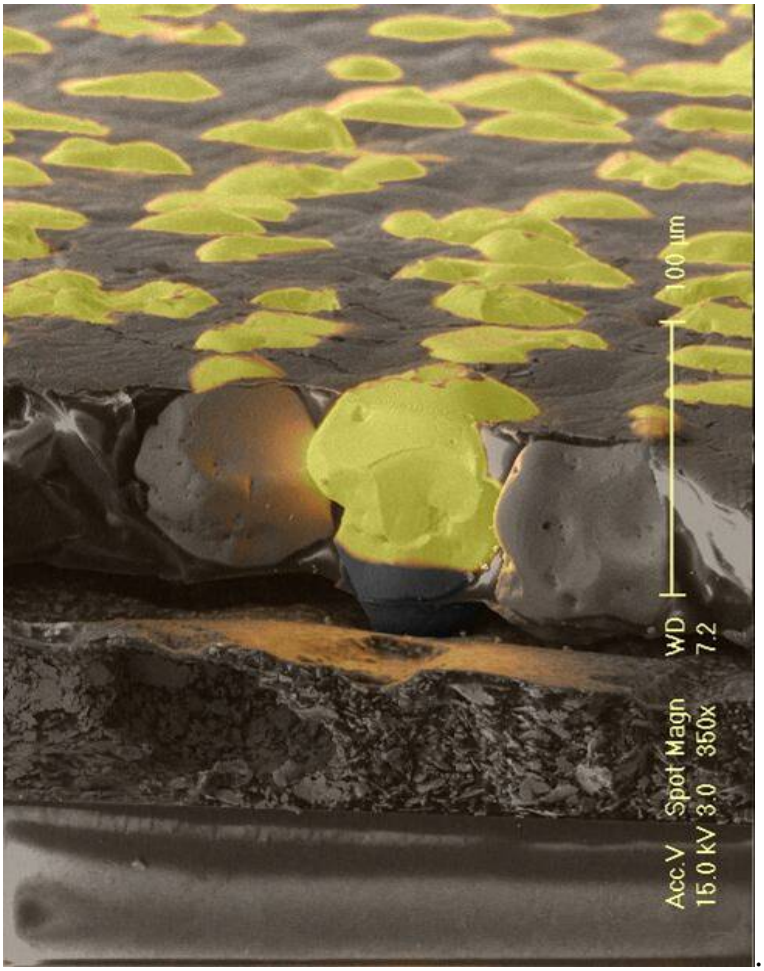

Fig. 2. Elecron Beam Induced Current (EBIC) and SEM combination micrograph shoving the active (yellow) mono-grains on the conductor. The black material between grains is epoxy which is used to form the grain mat.

The history of PV in Finland goes back to early 1980's when Neste Advanced Power System (NAPS) was founded. Although there were both intensive research activity (in Microchemistry/NAPS 1987 – 1997) and trials to start both thin film and c-Si PV manufacturing this activity did not lead into industrial level manufacturing of PV cells or modules in Finland. NAPS Systems has some own module manufacturing through Arctic Solar in Sweden but it mainly acts as PV system house with global coverage. However there are companies working on manufacturing equipment (like Endeas making solar simulator) and materials (like Luvata making copper ribbons for connectors used in silicon cells).

Appendices:

Photovoltaic Technology Platform: A Strategic Research Agenda for Photovoltaic Solar Energy Technology, European Communities, (2007)
IEA PVPS Annual Report 2006, (2007)
PV in Europe Series: Norway, Photon International, 10/2007, p.40 – 71
PV in Europe Series: Sweden, Photon International, 9/2007, p.50 – 87