Different types of photovoltaic (PV) cells

There are many different types of PV technologies, but the market is dominated by crystalline silicon (c-Si) based PV cells. Nearly 80% of the cells on the market are c-Si based cells, either monocrystalline or polycrystalline.

1.1 Crystalline PV cells

Monocrystalline and **polycrystalline** c-Si cells are wafer-based with thicknesses in the 250…100 µm range and lengths from 100 to 150 mm. The monocrystalline structure produces a homogeneous
color whereas the polycrystalline cell shows different shades for each crystalline orientation (see figure "Monocrystalline and polycrystalline PV cells").
The wafers are produced from a silicon melt (using different methods), condensed into blocks and then cut with a wire saw (see figure "Manufacturing process for crystalline PV cells"). The manufacturing processes are energy intensive since high temperatures are required to ensure high wafer purity and to remove defects.
Monocrystalline PV cells tend to achieve slightly higher efficiencies than polycrystalline cells. However, the manufacturing costs of polycrystalline cells are lower which compensates for their lower efficiency.
Screen printing is used to deposit the electrical contacts on both front- and back-sides of the cells.
Metal strips connect the front-side of a cell with the back-side of the next cell in order to form a string of cells in series. Crystalline silicon cells have a silicon nitride antireflection layer, which gives them their characteristic blue color.

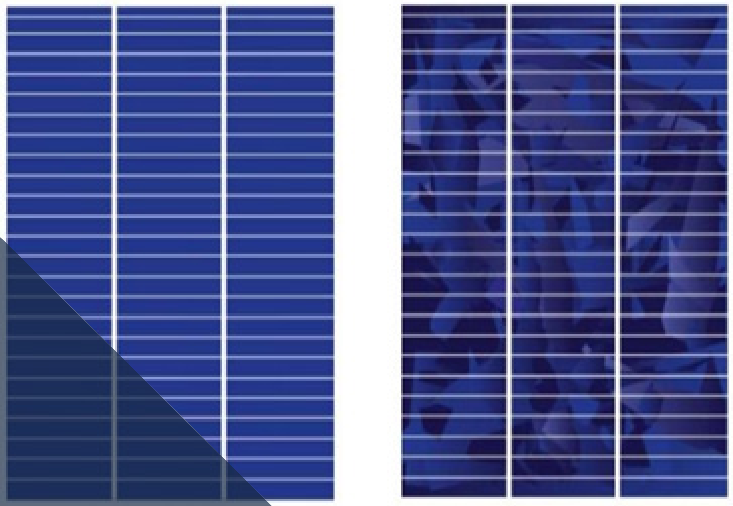

Figure 1: Monocrystalline (left) and polycrystalline (right) PV cells

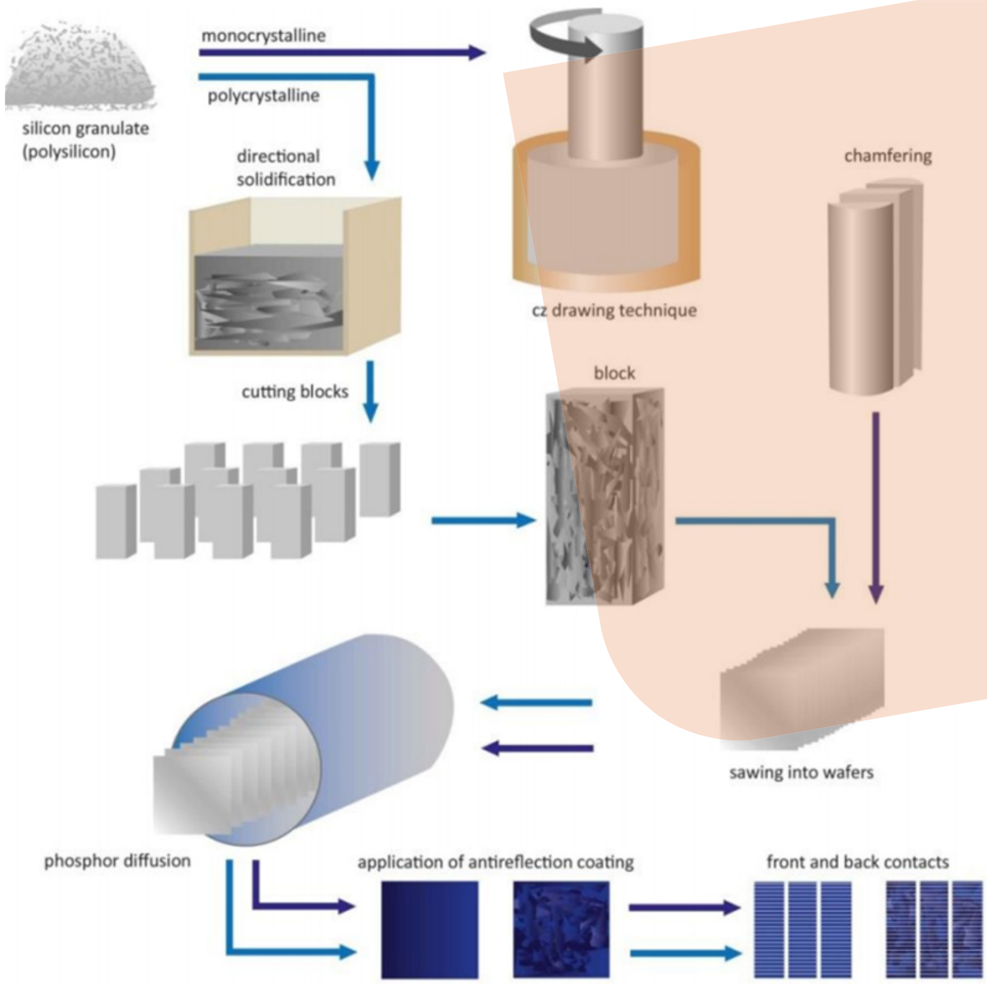

Figure 1:Manufacturing process for silicon crystalline cells

1.2 Thin-film PV cells

Thin-film PV cells (amorphous Si, cadmium telluride, CIGS) are typically deposited on glass sheets. The surface is then prepared with a laser and the electrical contacts deposited. The energy consumed for thin-film fabrication is much lower than for c-Si cells because the deposition is a low-temperature process. The manufacturing process is therefore much faster and lower cost than that of c-Si, however, thin-film PV cells have lower efficiencies than c-Si PV cells.

The main thin-film PV technologies currently on the market are:

1.2.1. Amorphous silicon (a-Si): This is the non-crystalline form of silicon. It was the first thin-film material to yield a commercial product and was used in consumer items such as pocket calculators. It can be deposited in thin layers onto a variety of surfaces.

1.2.2. Cadmium telluride (CdTe): CdTe is a semiconductor compound formed from cadmium and tellurium. CdTe cells are deposited directly onto glass. These modules are the most common type of thin film PV module on the market and the most cost-effective to manufacture at this time. CdTe modules perform better at high temperatures and in low-light conditions than crystalline-based modules due to their physical properties. However, the overall efficiency is significantly lower.

1.2.3. Copper indium gallium sulphur selenide (CIGS): CIGS is a compound semiconductor that can be deposited onto many different materials. CIGS has only recently become available for small commercial applications. It is considered to be a developing PV technology with high potential due to high efficiencies obtained in the laboratory.

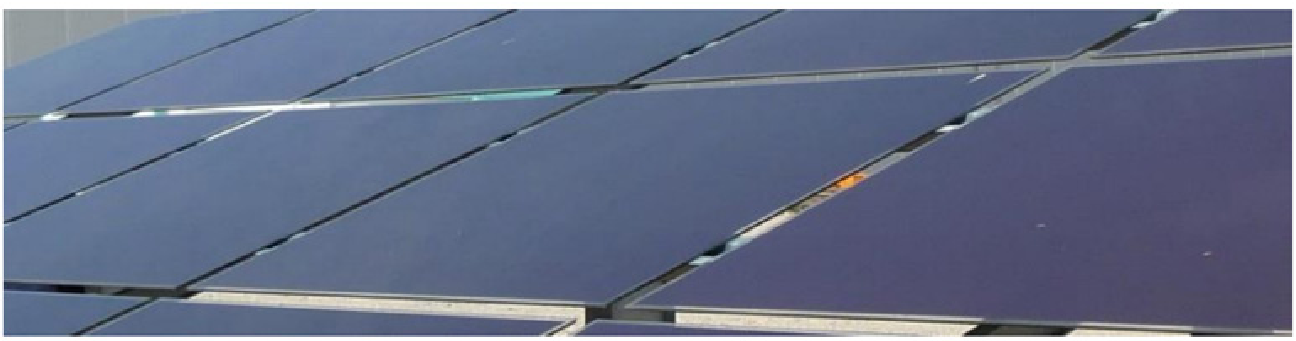

Figure 1:Thin-film modules

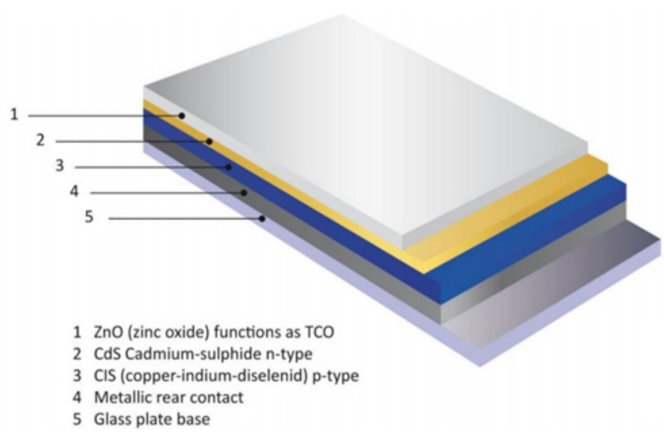

Figure 1:Copper indium PV cell structure (TCO: transparent conductive oxide)

CIRCUIT ENERGY

1.3 New Technologies

Concentrating photovoltaics (CPV) uses lenses to concentrate sunlight from a wider area onto a very small PV cell. In theory this will reduce the cost of the PV array and the land area required for a specific rated power capacity. However, these systems require high levels of direct radiation and the mounting structures need to track the sun with a high degree of accuracy. High radiation concentration also causes high currents in the PV cell so that series resistance constitutes a problem. Cooling is required to reduce cell temperature and related power losses.
Organic PV cells use an electro-chemical process similar to photosynthesis.Possible advantages include:

- low material manufacturing costs with low energy input,
- no heavy metals or other toxins needed in manufacturing,
- easy to dispose of and
- possibility to ‘print’ on a range of different surfaces.

Dye sensitized PV cells use a porous sponge-type structure of the titan oxide which increases the surface area about 1000 times. Material costs for this technology are low and the production process is simple, however, the physics of the dye cell is very different from all other PV cells and needs further research.

In the upcoming whitepapers we will discuss more about PV modules, how they are made and their technical specifications. To benefit from the advantages of going solar, send us an Email, we will get back to you as soon as possible.

www.circuitenergy.ca

70 East Beaver Creek Rd unit 32 Richmond Hill, ON L4B 3B2 Phone : 1 866 895 4545