The science behind innovation

There is no better place to start looking for innovation than at the scientific level with research that is not commercially vested in promoting any single product or technology. **Argonne National Laboratory**, Center for Nanoscale Materials (Argonne, IL) is one such centre. Argonne is a resource available to any company which wants to take advantage of leading edge technology.

Dr. Seth B. Darling, assistant scientist for Argonne says that there are a number of advances that look very promising in reducing the cost of solar cells, including novel desensitised solar cells using atomic layer deposition (ALD). "ALD allows three dimensional structures to be very thinly conformally coated. This reduces the distance that charges within the device have to travel".

Another is advanced luminescence concentrators. Conventional solar concentrators are large devices that track the sun. "This type of concentrator is stationary and it operates efficiently under diffuse light, which is what you need in low sun areas. We have developed a model to optimise parameters associated with this type of concentrator and we are using that to direct the development of some materials that are based on quantum dots. These are nanocrystals of inorganic semiconductor materials. It provides high luminescence efficiency and the nature of quantum dots allows tune-ability. You can tune their band gap, or tune the amount of energy they absorb. It also allows you to capture the very broad light spectrum, even into the near infrared part of the spectrum. There's a lot of the energy that other solar technologies are not capturing," he says.

"Argonne sits at the interface between the long-term research academia and industry. This is an important place to be. You need that unbiased bridge between the two worlds," Darling says. "Ultimately of course, we are not a company, so our goal is to hand off our findings to a partner."

Intermolecular, (San Jose, CA) is a different type of research resource. It focuses on combinatorial R&D i.e. performing multiple levels of similar research simultaneously.

"Our equipment looks like a semiconductor processing tool, but it is specifically built for high volume R&D. You can process many experiments very quickly in the same chamber in parallel as opposed to doing them one at a time using an entire solar substrate," J. Craig Hunter, vp and GM solar and energy technologies, says.

Whether crystalline or thin film, Hunter notes that even minor changes in processing will have an impact on the final product. Before making the investment to move into full production it is critical to understand exactly what your process windows are and exactly what the tolerances are for each of the individual process parameters.

"We offer a very IP secure way of doing that on a one-on-one basis with our customers," Hunter says. "We can process a thousand unique solar cells per week, each with a different variation on critical things that affect the performance of that device. We also have software and metrology systems that quickly and fully characterise all solar cells and store it so the data can be accurately compared and analysed."

Helping support innovation

Components, equipment and materials also fall into innovations that help PV manufacturers enhance both products and processes.

Components

BioSolar (Santa Clarita, CA) is on a mission to replace components used within photovoltaic modules with something "greener". This may sound like an oxymoron, but in truth, while solar is helping us move toward a renewable energy source, many PV component are not necessarily green. For example, the main material in backsheets is typically petroleum. BioSolar's alternative is called the *BioBacksheet*.

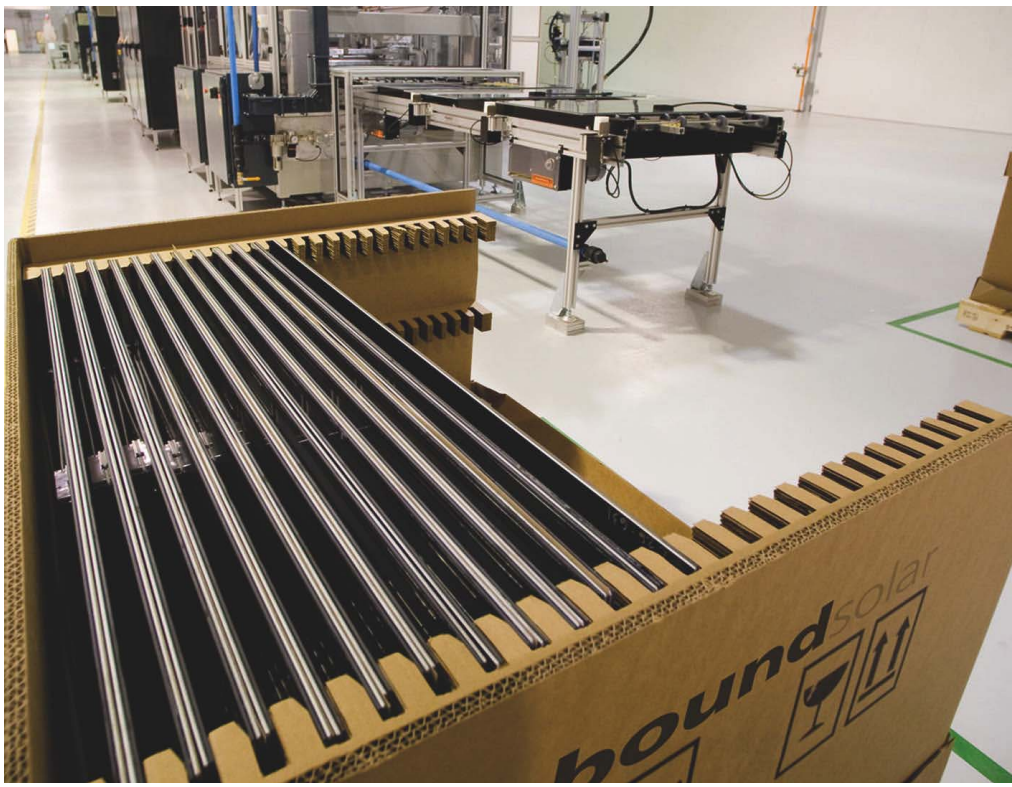
"There are several different types of backsheets, but all are petroleum based. 90 percent of crystalline and certain amorphous silicon thin film use one type. More modern thin films, CIGS and Cadmium telluride also use a backsheet but they have more stringent requirements. They need an absolute moisture barrier," David Lee, ceo says.

BioBacksheet uses a proprietary formulation based on cotton and a form of nylon resin made from castor bean oil. Lee says that it provides a perfect moisture barrier environment as well electric insulation.

The company is just gearing up to go into limited production. Samples will be available for all PV manufacturers to test by early 2010.

Equipment

Tyco Thermal Controls based in Menlo Park, CA came to the TFPV via semiconductors and then through flat screen TVs. "We had the big flat heaters that are needed to heat the flat screens and it was just a step to taking



End of Abound Solar manufacturing line, including final packaging (Courtesy of Abound Solar)