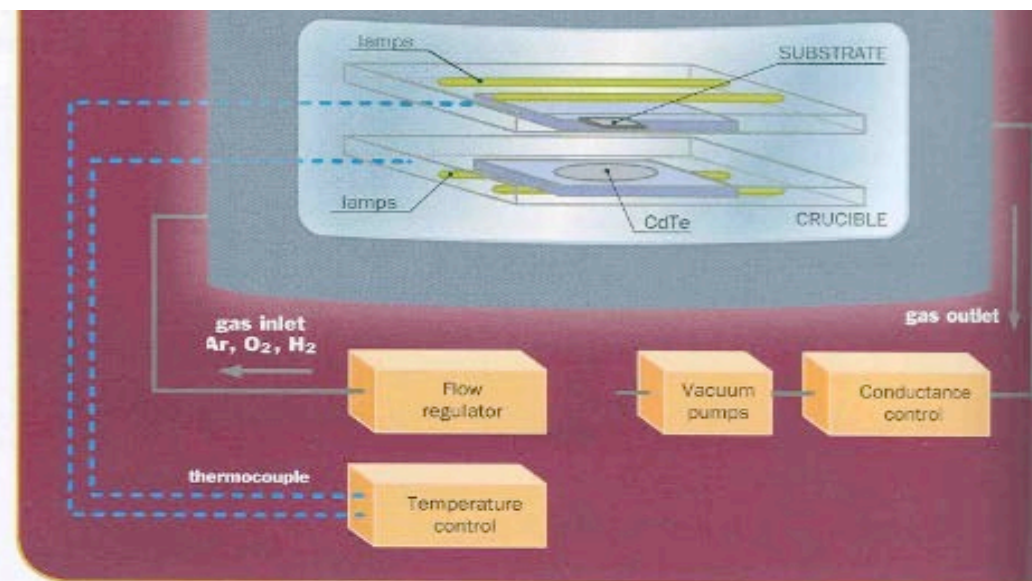


Thin Films: Italy leads the way

Scientists at Parma University have developed an innovative production technique for making high efficiency cadmium telluride (CdTe) thin film cells using a low cost process that gives a complete and easy reproducibility. The first manufacturing plant will start up within two years and the cells will be available on the market immediately after.



About 90 per cent of the cells on the market today are produced using the consolidated technology of mono- and polycrystalline silicon with the rest being almost entirely made using amorphous silicon and polycrystalline silicon thin film technology. Silicon is not in effect a substance suitable for thin film technology due to its difficult working properties (it requires high temperatures and a high vacuum) and due to the physical characteristics of this semi-conductor. Without considering refined techniques such as multi-junction devices which have high production costs, thin film silicon photovoltaic modules have shown to have low efficiency and poor stability. Thin film technologies for the manufacture of photovoltaic modules have, however, the undoubted advantage of being very suitable for large-scale production in which the panel represents the final step of the in-line processes and not



the assembly of smaller sized cells, as is the case with modules based on crystalline silicon wafers. The higher production outputs (in terms of square meters of modules in a given time unit), together with the small quantities of active material required, lead one to foresee that in the future these types of modules will compete with those coming from traditional sources. Therefore, over the past few

years other materials have been introduced and studied to create the photovoltaic junction in the form of thin films, and amongst these the most promising are CIS (copper-indium-diselenide) and CdTe (cadmium telluride). These two types of cells have been intensively studied over the past 20 years by the research group led by Professor Nicola Romeo of the Physics Department of Parma

THE PROJECT ENTHUSIASTS

Interview with Roberto Garavaglia, Managing Director of Arendi Srl and of Euroenergy Group, part of the Marcegaglia Group.

What were the main reasons that led the Marcegaglia Group to invest in this CdTe thin film cell project?

First of all because we have been in the field of renewable energy for about 10 years. We started with the construction and management of plant for the production of electrical energy from biomass and for fuel derived from waste, and the investment in photovoltaics represents, therefore, a natural development of our industrial strategy. Secondly, our Group is present in the construction field where we manufacture metal products for the building industry, in particular covering panels also for roofs. As a consequence, photovoltaic modules and covering panels make a natural integration to our production line.

How are you involved in the project for the realization of CdTe cells?

We are the industrial partner in the group of shareholders of Arendi Srl, the company that will have the responsibility of

Professor Romeo's group had been looking for an industrial partner for some time and the "match" was almost automatic. At the moment we are starting the design and realization of the industrial plant for the manufacture of the cells and we will need at least a couple of years before they will start to be marketed. Initially the plant will have a capacity of 15MW and will therefore, for the initial period, supply above all the Italian market.

What are the most interesting aspects of the project?

Thin films are a novelty for Italy, where the entire photovoltaic sector represents something new, and it interested us because it frees us from silicon procurement. Secondly, from what we have been able to ascertain, today many companies are suffering from a lack of raw material, of the silicon feedstock. This film opens an interesting market for us



NEAR TO THE COST OF FOSSIL FUEL SOURCES

Interview with Marco Bianucci, researcher at the Istituto Nazionale di Fisica della Materia (INFM), Parma and originator of the project to transfer the technology from the laboratory to industry.

What is the most innovative property of the technology that you are developing?

CdTe thin film technology is innovative on the market because currently, it is only used marginally compared to that of silicon. In the context of CdTe technology, our innovations lead to efficient modules that are more stable in time and easier to reproduce using a remarkably simplified production process. Having been entirely developed by SEE, these innovations are completely "Made in Italy".

What are the advantages in economic terms and in performance of this new technology?

The modules will have a size of 120 x 60 centimetres and will be designed, above all, for residential applications. The advantages are essentially in the cost and in the stability in time. In fact, having resolved the problems of efficiency, stability and reproducibility and having simplified the production process, the manufacturing cost of a module will be that foreseen for some time for state-of-the-art CdTe thin film: slightly over EUR 0.5/Wp. Obviously as at the start our plant will be under dimensioned compared to the market demand, the real cost to the user will be conditioned by the same market. It should be noted that there are some important reasons that make thin film modules competitive compared to those in silicon. First of all the quantity of material used is at least 100 times less than that used to produce mono- and poly-crystalline silicon based modules and is a negligible part of the total cost. Secondly, the manufacturing process can be completely automated (it is a line with a belt conveyor), therefore a plant produces many more modules per hour than a line using silicon. Thirdly, low cost substrates, such as common glass are used. A cost lower than 0,5 dollars/Wp is foreseen for a production of over 10 MWp/year, which is getting close to the price for electrical energy produced by fossil sources. In fact, among the materials used the most dominant cost for the production of these modules is that of



From left:
Alessio Bosio
and Marco
Bianucci

of Parma University standing next to two CSS chambers for CdTe deposition, realized by Professor Bosio

the glass support, which is, by the way, common float (or soda-lime) glass.

When will the plant start up and when will the modules be available on the market?

The plant will presumably start up within 18-24 months and soon after the modules should arrive on the market. Currently there are no research institutes involved in the industrial project, even if there are agreements with Parma University, Verona University and one is currently in an evaluation stage with the CNR (Consiglio Nazionale delle Ricerche - National Research Council). The consortium has won a call for bids published in the Lombardy Region Official Gazette that, through a protocol of intent between the Environment Ministry and the Lombardy Region for the development of innovative photovoltaic technology, includes a co-financing (50 per cent maximum) of up to EUR 9 million for the winning project.

Today does it make more sense to purchase modules available on the market now or wait until new, less costly and more efficient technologies, like yours, are developed?

With the actual incentives it certainly makes sense to purchase the available modules, but one needs to have a certain initial capital to invest. Within a few years costs should be so much lower to free the market from public incentives.

University, in particular in the context of some projects financed by the European Union. The conclusion of the research was the net preference for CdTe based cells as these showed improved reproducibility and are better suited to a low cost industrial type production, above all due to the simplicity of the deposition processes. The research led by Professor Romeo, with the collaboration of Professor Alessio Bosio, resulted in the realization of cells with an efficiency of over 15 per

Nicola Romeo and Alessio Bosio, together with other researchers and managers in the commercial sector, founded Solar Systems and Equipments (SEE) S.r.l., a company whose aim is to refine the technology to pass to the true industrial development stage. Based on laboratory results, SEE s.r.l. has deposited a series of industrial patents that protect the fundamental production process phases and that make low cost large scale production realistic. In autumn 2006

ive majority partner), Solar Systems and Equipments S.r.l. (25 per cent share, also with the responsibility of research and scientific and technological innovation), Alchimia S.p.A. (15 per cent, the Holding Company of Marina Salamon), Banca Ifis S.p.A. (a financial partner with 15 per cent), and Studio Galli Ingegneria S.p.A. (an engineering concern with 5 per cent). To understand what stage the industrial project has reached we interviewed Roberto Garavaglia, Managing