

Thin-film solar cells and modules: research, development, and perspectives

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27.11.2008 17:30

Auditoire B02 Campus Kirchberg

Solar energy conversion into electricity has the highest technical potential among all renewable energy sources and in most long term scenarios plays a dominant role in the energy mix beyond 2050. The direct conversion of solar energy into electricity by solar cells and modules is one of only two available technologies for the generation of solar electricity. During the last decade, the world-wide production of solar modules has increased steadily with an annual rate of more than 25 %. Especially in Germany a fast growing photovoltaic industry has developed. However, the contribution of photovoltaics to the electricity production worldwide is still below 1 % and the cost of photovoltaic electricity is still too high for competitiveness on the energy market. A cost reduction by almost a factor of two is necessary to bring the price of photovoltaic electricity to grid parity and another factor two to three for becoming competitive to wholesale electricity.

At the moment 90 % of the photovoltaic market is covered by classical crystalline silicon solar cells. Nowadays, new thin-film technologies with a high potential of cost reduction enter the market. These technologies based on amorphous/microcrystalline silicon (a-Si/ μ c-Si) or on the compound semiconductors $\text{Cu}(\text{In,Ga})(\text{S,Se})_2$ or CdTe are now in a critical stage of their economic development and have to prove their promises in the next future.

The lecture will discuss the present status of thin-film solar module research and development for the three different technologies: a-Si/ μ c-Si, $\text{Cu}(\text{In,Ga})(\text{S,Se})_2$ and CdTe. The requirements for large-area deposition of high quality materials will be considered as well as additional production steps like laser scribing and the final quality control of the finished device.

Uwe Rau studied physics in Tübingen, Lyon, and Grenoble, and received his PhD from the University of Tübingen in 1991. He then held postdoc positions at the Max-Planck-Institut für Festkörperforschung in Stuttgart, the Sony Research Center in Yokohama, and the University of Bayreuth before becoming a scientific group leader at the Institut für Physikalische Elektronik of the University of Stuttgart in 1997. Since 2007 he is full professor at RWTH Aachen and director of Institute of Energy Research-5: Photovoltaics of the Forschungszentrum Jülich.

