LOW COST $Cu(In,Ga)Se_2$ SOLAR CELLS FROM NANOSIZED PRECURSORS

M. Kaelin, T. Meyer [a], A. N. Tiwari [b], S.E. Pratsinis [c]

Thin Film Physics Group, ETH Zürich, Technoparkstrasse 1, CH-8005 Zürich
[a] Solaronix SA, Rue de l'Ouriette129, 1170 Aubonne VD
[b] also at: Dept. of Electronic and Electrical Eng., Loughborough Univ., UK.
[c] Particle Technology Laboratory, Institute of Process Engineering, ETH Zurich, Sonneggstrasse 3, CH-8092 Zürich,

Wafer based silicon solar cell technologies are now mature and capture 90% of the photovoltaic market, but are still expensive for their widespread use in electric power generation. Thin film solar cells that present many advantages in processing, have the potential to substantially cut the manufacturing costs.

$Cu(In,Ga)Se_2$ (CIGS) is one of the favorite candidates for high efficiency and long term stable cells. The conventional manufacturing process involves sophisticated vacuum deposition technology to deposit the CIGS layer. CIGS solar cell production cost can be lowered by using a two step process:

1) A precursor layer is deposited by simple and fast deposition technique.
2) The precursor layer is subjected to a reactive sintering step by rapid thermal processing.

Non-vacuum deposition technologies are of particular interest because of their low cost and ease of processing. Materials costs are reduced by a high material utilization yield of paste coating techniques. The challenge is to find a suited precursor material which allows uniform thin film deposition and a fast chemical conversion to ~ 1 micron thin CIGS layers with proper stoichiometry, free of impurities.

A novel low-cost precursor material was deposited by the doctor blade technique and selenized in a quartz tube at 10mbar for about 10min. at 550°C. No dangerous H_2 and toxic H_2Se gases were used for the chemical reaction. The conversion to the CIGS phase was confirmed by X-ray diffraction, while grain size and morphology were characterized with electron microscopy. Thin CIGS layers grown on Mo/glass were processed to solar cells by applying a CdS buffer and ZnO/ZnO:Al front contact, a maximum efficiency of 6.7%was achieved with ~0.5 micron thick absorber layer.