Boosting the efficiency of CIGS by optimal use of MoNa sputtering targets.

Together with Plansee, the Laboratory for Thin Films and Photovoltaics at the Swiss Federal Laboratories for Materials Science and Technology (Empa) investigated the ideal sputtering parameters for achieving high efficiency of CIGS cells.

Small quantities of sodium in the CIGS absorber improve the efficiency of a CIGS cell. The use of sputtering targets made from molybdenum-sodium (MoNa) allows CIGS manufacturers to achieve a homogeneous distribution of sodium and precisely control of the sodium content.

Empa investigated the ideal sputtering parameters for achieving high efficiency. The outcome: Efficiency levels of up to 15%. The results were published in Volume 124 of Solar Energy Materials & Solar Cells.
Targets with a sodium content of 3, 5 and 10 at.% were tested in the sputtering experiments. As expected, higher sodium content in the target produced higher concentration of sodium in the CIGS absorber. A 300 nm layer with a sodium content of 10 at.% resulted in considerably more sodium in the absorber than a reference sample deposited on soda-lime glass. The researchers therefore used this target material for further experiments, because a significantly thinner molybdenum-sodium layer is sufficient to achieve similar results compared to targets containing 5 at.% sodium.

Correct sputtering parameters have an even greater influence on the efficiency of the CIGS cell than the appropriate coating material. As the argon pressure in the sputtering chamber rises, the porosity and the number of grain boundaries of the sputtered layer also increases. Sodium tends to collect at the grain boundaries and diffuses from the MoNa layer into the CIGS absorber through these grain boundaries. With optimized sputtering parameters, the amount of Na in CIGS could be increased by almost a factor of seven.

The research experiment also demonstrates that sodium diffuses from the MoNa layer into the CIGS absorber even at low temperatures. This means that MoNa targets are eminently suitable for manufacturing processes that require relatively low temperatures, such as the production of CIGS solar cells on plastic film.

The detailed findings of this research have been published in the article entitled „Sodium-doped molybdenum back contact designs for Cu(In,Ga)Se2 solar cells“, in Solar Energy Materials & Solar Cells, 2014, Volume 124, pp 10-16, published by Elsevier.