To the Media

Stuttgart, 13 February 2020

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

Location: Meitnerstr. 1,
70563 Stuttgart
Germany

Deeper Insights into Solar Cells' Anatomy

ZSW puts new scanning electron microscope into operation

Scientists at the Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) now have a far more powerful tool to better investigate solar cells – a new scanning electron microscope. In full operation since January 2020, this device has twice the resolution of its predecessor and the ability to image structures measuring just a few nanometers. Its focused ion beam cuts cross-sections of layers smoothly and precisely. Researchers aim to gain a better understanding of thin-film solar cells' structure and interfaces on a nanoscale. They also want to gain deeper insights into defects. This knowledge is crucial to the solar industry's efforts to assure quality and continue to boost solar cells' efficiency. More efficient solar cells can further shrink photovoltaic systems' small CO_2 footprint and boost PV's contribution to mitigating climate change.

A video at www.zsw-bw.de/mediathek/filme.html shows the advantages of the new scanning electron microscope with a focused ion beam – or FIB-SEM for short.

High-resolution scanning electron microscopes are excellent analytical instruments for developing thin-film solar cells based on copper, indium, gallium and selenium (CIGS). The same goes for other solar cells such as perovskites. These tools furnish information about layer growth and thickness, morphology and chemical composition. They scan with an electron beam and render the smallest surface structures in three-dimensional images. These pictures help researchers spot undesirable cavities and foreign particles in the materials.

Nanoscale views for more nuanced observations

The new FIB-SEM at the ZSW is able to detect image points less than a nanometer apart. Solar cells' structures are clearly visible down to a scale of ten nanometers, or 0.00001 millimeters. "The device opens up new possibilities for us in the investigation of thin-film solar cells," says Dr. Theresa Friedlmeier, group leader Analytics and Simulation at the ZSW Department of Photovoltaics: Materials Research. "We can now analyze the shape and size of particles and inclusions, and investigate micro-areas using energy dispersive X-ray spectroscopy."

The new device can serve to examine the very thin interface between the CIGS and the buffer layer of cadmium sulfide with far greater

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depth and precision. This interface has a major impact on solar cell efficiency.

Improved sample preparation with a focused ion beam

With its focused ion beam, the new scanning electron microscope enables researchers to prepare materials on a nanoscale. “For example, we can use it to prepare good cross-sections of CIGS solar cells on flexible substrates without damaging or separating the individual layers, which had been very difficult in the past,” says a clearly delighted Friedlmeier. “It helps us to deepen our understanding of solar cells and develop improved processes with higher efficiencies and lower costs.” The state of Baden-Württemberg funded this new acquisition with a €650,000 grant.

The researchers will also use the new equipment to prepare the samples for further investigations. These include electron backscattering, transmission electron microscopy, atom probe tomography and energy dispersive X-ray analysis.

About ZSW

The Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (Centre for Solar Energy and Hydrogen Research Baden-Württemberg, ZSW) is one of the leading institutes for applied research in the areas of photovoltaics, renewable fuels, battery technology, fuel cells and energy system analysis. There are currently around 260 scientists, engineers and technicians employed at ZSW’s three locations in Stuttgart, Ulm and Widderstall. In addition, there are 90 research and student assistants.

Media contacts ZSW

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A ZSW researcher at the new scanning electron microscope

Photo: ZSW

The new scanning electron microscope in the ZSW laboratory

Photo: ZSW

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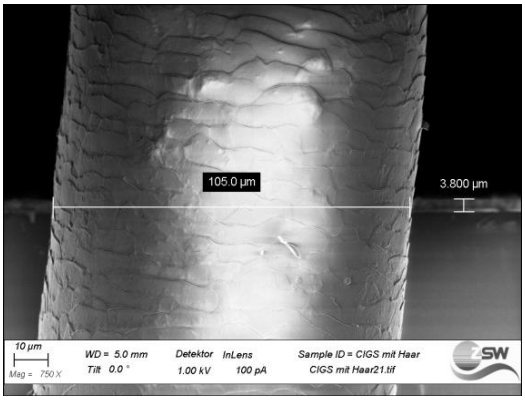
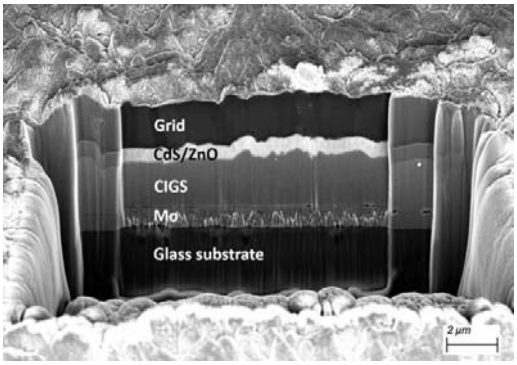


Comparing the size of a human hair (105 microns) with that of a CIGS thin-film solar cell (3.8 microns) in the new scanning electron microscope at ZSW

Photo: ZSW



A cross-section of a CIGS thin-film solar cell with the new scanning electron microscope

Photo: ZSW

Images are available from Solar Consulting or at https://energie.themendesk.net/zsw/.