Low-cost solution processing method developed for CIGS-based solar cells

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Though the solar industry today predominately produces solar panels made from crystalline silicon, they remain relatively expensive to make. New players in the solar industry have instead been looking at panels that can harvest energy with CIGS (copper-indium-gallium-selenide) or CIGS-related materials. CIGS panels have a high efficiency potential, may be cheaper to produce and would use less raw materials than silicon solar panels. But unfortunately, manufacturing of CIGS panels on a commercial scale has thus far proven to be difficult.

Recently researchers at the UCLA Henry Samueli School of Engineering and Applied Science have developed a low-cost solution processing method for CIGS-based solar cells that could provide an answer to the manufacturing issue. In a new study to be published in the journal *Thin Solid Films* on July 7, Yang Yang, a professor in the school's Department of Materials Science and Engineering, and his research team show how they have developed a low-cost solution processing method for their copper-indium-diselenide solar cells which have the potential to be produced on a large scale.

"This CIGS-based material can demonstrate very high efficiency," said William Hou, a graduate student on Yang's team and first author of the study. "People have already demonstrated efficiency levels of up to 20 percent, but the current processing method is costly. Ultimately the cost of fabricating the product makes it difficult to be competitive with current grid prices. However, with the solution process that we recently developed, we can inherently reach the same efficiency levels and bring the cost of manufacturing down quite significantly."

The copper-indium-diselenide thin-film solar cell developed by Yang's team achieved 7.5 percent efficiency in the published study but has in a short amount of time already improved to 9.13 percent in the lab.

"We started this process 16 months ago from ground zero. We spent three to four months getting the material to reach 1 percent and today it's around 9 percent. That is about an average increase of 1 percent every two months," said Yang, also a member of the California NanoSystems Institute, where some of the work is being done.

Currently, most CIGS solar cells are produced using vacuum evaporation techniques called co-evaporation, which can be costly and time-consuming. The active elements — copper, indium, gallium and selenide — are heated and deposited onto a surface in a vacuum. Using vacuum processing to create CIGS films with uniform composition on a large scale has also been challenging.

The copper-indium-diselenide material created by Yang's team does not need to go through the vacuum evaporation process. Their material is simply dissolved into a liquid, applied and baked. To prepare the solution, Yang's team used hydrazine as the solvent to dissolve copper sulfide and indium selenide in order to form the constituents for the copper-indium-diselenide material. In solar cells, the "absorber layer" (either copper-indium-diselenide or CIGS) itself is the most critical to performance and the most difficult to control. Their copper-indium-diselenide layer, which is in solution form, can be easily painted or coated evenly onto a surface and baked.

"In our method, material utilization is one advantage. Another advantage is our solution technology has the potential to be fabricated in a continuous roll-to-roll process. Both are important breakthroughs in terms of cost," said Hou.

The team's goal is to reach an efficiency level of 15 to 20 percent. Yang predicts three to four years before commercialization.

"As we continue to work on enhancing the performance and efficiency of the solar cells, we also look forward to opportunities to collaborate with industry in order to develop this technology further. We hope this technology will lead to a new green energy company in the U.S., especially here in California so that it may also bring job opportunities to many who need it," said Yang.

Source: University of California - Los Angeles

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