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The National Institute of Advanced Industrial Science and Technology

(English version)

Development of a Low-cost Metal Substrate for CIGS Solar Cells

- 16 % conversion efficiency is achieved in CIGS solar cells using a low-cost low-carbon steel based substrate -

Toyo Kohan Co., Ltd. and the National Institute of Advanced Industrial Science and Technology (AIST) achieved high efficiency of CIGS solar cells employing a low-cost metal substrate. Expansion in demand for CIGS solar cells as the next generation solar cells is highly expected. Toyo Kohan aims at the commercial production of this newly developed metal substrate in around 2011.

CIGS solar cells have the highest conversion efficiency among thin film solar cells and are expected as the post-crystalline silicon solar cell. As their substrate, glass has been conventionally employed. Recently, however, technologies for CIGS film growth on a metal substrate for flexible solar cell modules are developed, and various applications of the modules including BIPV (Building Integrated Photovoltaics) are expected.

Titanium and molybdenum sheets which do not have adverse effects on CIGS solar cells have been employed as metal substrates in previous studies. In commercialization, however, they have some problems related to large-area material supply and cost performance. Therefore, cheaper stainless steel foil is also studied, but some elements of the stainless steel diffuse into the CIGS film during the high temperature process and inhibit the high efficiency of the CIGS solar cell.

Toyo Kohan newly developed an ultra-thin metal substrate using low carbon steel as the base, which enables lower cost than stainless steel foil. The metallic base material before surface treatment could realize 1/10 or less price of conventional titanium foil, about the half price of stainless steel foil, and about 1/4 price of polyimide. Moreover, diffusion of elements which obstructs the high efficiency of CIGS solar cells is controlled by the film on the metallic base formed using Toyo Kohan's unique surface treatment. Previously, such a diffusion barrier layer was deposited through a high-cost vacuum process. In Toyo Kohan's technology, the barrier layer is formed in the atmosphere, and the process enables lowering the process cost.

AIST has already achieved the efficiency at the world's highest level in a CIGS solar cell, and also has been studying flexible solar cells using metal substrates. Furthermore, AIST has carried out the development of large-area solar cell modules, as well as researched lower-cost substrates better suited for commercial use.

AIST made a CIGS solar cell using the Toyo Kohan's low-cost metal substrate with the surface treatment, and demonstrated 16.7% as the active area efficiency (cell active area=0.5cm²). This value is very high as a CIGS solar cell with low-cost substrate.

Both cold rolling and surface treating of ultra-thin steel sheets are the key technologies of Toyo Kohan. Thus, Toyo Kohan can manufacture ultra-thin (less than 100μm) and wide (500-1,000mm width) sheets of surface treated steel; the thickness and width of the sheet is necessary for the substrate of flexible CIGS solar cells. Toyo Kohan aims at the commercialization of the newly developed metal substrate in around 2011 and at the wide variety of applications of the substrate.