A flexible CIGS solar cell with energy conversion efficiency of 17.7 %

Enabling development of a sticker-type high-performance solar cell

We have developed a technique for dramatical improvement of the energy conversion efficiency of flexible solar cells that utilize CIGS, a non-silicon semiconducting material made from copper (Cu), indium (In), gallium (Ga), and selenium (Se). Using this technique, high-performance solar cells with a variety of flexible substrates such as metal foils, ceramics sheets, and polymers are fabricated. The thickness of the CIGS photoelectric conversion layer is very thin in the order of several micrometers. Owing to this feature, lightweight and flexible solar cells that can be installed on a curved surface and portable solar cells are expected to be realized. It has been difficult to develop high-performance flexible CIGS photovoltaic cells so far. By the development of a new controlled alkaline addition technique and a new polymer substrate handling technology, the energy conversion efficiency of the flexible CIGS solar cells is dramatically enhanced. Using this technique, an energy conversion efficiency of 14.7 % has been demonstrated using a polyimide substrate with the use of a low temperature (400°C)-grown CIGS absorber layer. In addition to this, 17.7 % efficiency has been demonstrated using a flexible zirconia ceramics sheet substrate (the CIGS absorber layer was grown at 550°C).

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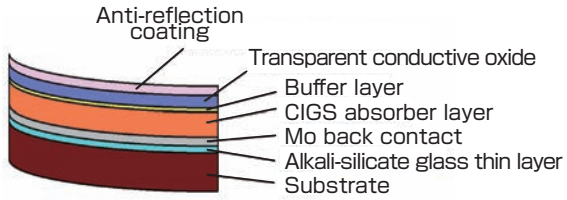

Schematic of the structure of the flexible CIGS solar cell developed in the present work

Development of a visible light responsive photocatalyst using tungsten oxide

Complete oxidative decomposition of various volatile organic compounds under visible light

We have developed a tungsten oxide (WO_3) visible light responsive photocatalyst that can be activated to a high enough level to enable the complete oxidative decomposition of various volatile organic compounds (VOCs) under visible light illumination including fluorescent lighting indoors or in vehicles, where little ultraviolet (UV) light exists. Complete oxidative decomposition means completely oxidizing an organic substance by decomposing the substance into carbon dioxide (CO_2) and water, and detoxifying it. We have succeeded in complete oxidative decomposition of VOCs including formaldehyde, acetaldehyde, formic acid, acetic acid, and aromatic compounds such as toluene, which are known as a persistent substances. This photocatalyst has been realized by adding newly developed high-performance promoters, namely metallic palladium (Pd) and copper (Cu) compounds, to a WO_3 semiconductor photocatalyst. Activity improves dramatically simply by mixing promoter particles into the WO_3 powder. In acetaldehyde decomposition under visible light irradiation, the Pd added WO_3 photocatalyst showed an oxidative decomposition activity more than seven times that of a typical photocatalyst, titanium oxide (TiO_2).

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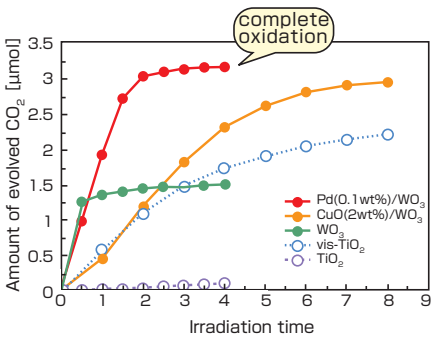

Time courses of CO_2 formation during photocatalytic degradation of acetaldehyde (ca. 1.6 μmol) under visible light irradiation (λ> 400 nm).
TiO_2: commercial powder.
vis-TiO_2: visible-light-active TiO_2.