

Material design for novel-concept-based solar cells —Sulfurization or oxidization of “cheap” metals

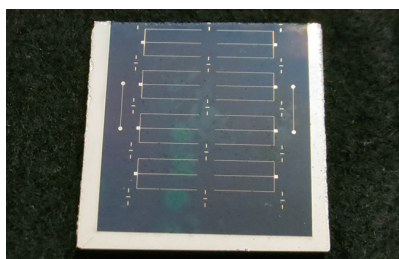
Mutsumi SUGIYAMA (Professor, Department of Electrical Engineering, Faculty of Science and Technology,
Tokyo University of Science)

Purpose of Research

- We have developed a novel method for fabricating a solar cell, which is safe and stable from manufacturing point of view as well as environmental friendly while disposing. The materials used for fabricating the solar cell are available at general hard-ware store that are inexpensive and harmless.
- We have proposed new ways to use the solar cell of oxide semiconductor (not limited to nickel oxide) as a transparent energy harvesting device.

Summary of Research

- We have considered an entire process (bottom to top approach) to develop novel concept-based solar cell. It includes searching a proper semiconductor material, investigating its electronic properties and engineering the materials for device fabrication. For example, SnS and Cu_2SnS_3 solar cells were fabricated by subjecting a copper (Cu) or tin (Sn) film or both to a heat process under a sulfur atmosphere.
- The solar cell fabricated using nickel oxide (NiO) is a transparent solar cell, which absorb only ultraviolet rays that is harmful to humans, and generate electricity. This type of solar cells can be installed even at location where the conventional solar cell cannot be used, for example windows or plastic greenhouses. Furthermore, they can also be used for preparing an invisible camera or sensor by combining with a transparent diode or transistor.



Comparison with Conventional or Competitive Technology

Since the silicon semiconductor, which constitutes approximately 90% of the solar cells currently produced requires highly pure silicon, hence the manufacturing cost increases. In a contrast, we have developed a next-generation solar cell which is safe, risk-free and has excellent performances that can be manufactured at a low cost.

Expected Applications

- Transparent window glass which generates electricity using ultraviolet rays
- Shade-type power generation window glass
- Employ such solar cell in the energy harvesting device (for example, a sensor which doesn't need electricity or an invisible security camera)

Challenges in Implementation

- Need to improve power generation efficiency and develop a way to use in new fields (proposals).
- Selection of safe and eco-friendly materials is important to develop environment-friendly, low cost, next-generation solar cell.

What We Expect from Companies

We are looking for collaborative project work with companies to develop safe, risk-free and inexpensive next-generation solar cell in not only field stated above but also in other various fields.

Points

- We have proposed a solar cell whose transparency gradually changed (NiO-based solar cell, photo on the left) and "a transparent intelligent glass" with high added value, which is made by combining transparent transistors (p-type TFT, photo on the upper right) and sensors
- We have managed the entire process from material development to device design e.g. fabricating solar cell with a safe and inexpensive materials like SnS (photo on lower right)

Future Developments

The currently available solar cells have several “economic” problems such as use of harmful materials, dangerous production processes, which result high manufacturing/materials costs. This study has a purpose to realize an inexpensive “next-generation solar cell” which can be safely manufactured and used with no risk.

- Intellectual Property: Japanese Unexamined Patent Application Publication No. 2013-109076 “Photovoltaic Light Control Element and Method for Manufacture the Same”
- Prototype: Present
- Sample: May be provided. Decision on this made after discussion with requester.