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Present status and future prospects for super low-cost Cu_2O-based solar cells

Toshihiro Miyata and **Tadatsugu Minami**
Kanazawa Institute of Technology, Japan

Oxide semiconductor thin films are very attractive materials for optoelectronic device applications, such as transparent conducting electrode and solar cells. Recently, a substantial improvement of conversion efficiency has been reported in solar cells fabricated using n-type oxide semiconductor thin films deposited on p-type cuprous oxide (p-Cu_2O) as the active layer. This paper describes the present status and prospects for further development of super low-cost Cu_2O-based hetero- and/or homo-junction solar cells. We have recently reported that the obtainable photovoltaic properties could be dramatically improved in p-n hetero-junction solar cells fabricated by depositing appropriate n-type oxide semiconductor thin films on p-type Cu_2O sheets that had been prepared by a thermal oxidization of copper sheets. The observed improvement suggests that it is necessary to stabilize the surface of techniques for applying the hetero-junctions. Consequently, the obtainable performance could be improved by not only the formation of an n-type oxide semiconductor thin-film layer, prepared using low-temperature and low-damage deposition methods such as pulsed laser deposition (PLD), but also the use of high-quality Cu_2O sheets. It shows the structure of Cu_2O-based p-n hetero-junction solar cells. The thermally oxidized polycrystalline Cu_2O sheets exhibited a resistivity on the order of 10^3 Ωcm, whole concentration on the order of 10^{13} cm^{-3} and Hall mobility in the range of 100-110 cm^2/Vs. For example, a high efficiency of 8.23% was obtained by AZO/n-type Zn1-X- GeX-O/p-Cu_2O hetero-junction solar cell fabricated by depositing using low-damage PLD on non-intentionally heated Cu_2O sheets. This is the highest value of the efficiency of hetero-junction solar cells using Cu_2O system. In addition, we will also describe that the fabrication of p-n homo-junction Cu_2O solar cells using i-type or n-type Cu_2O thin films grown by electrochemical deposited (ECD) method.

Biography

Toshihiro Miyata is a Professor at the Kanazawa Institute of Technology (KIT) in Japan and a Researcher of the Optoelectronic Device System R&D Center at KIT, where his interests center on optoelectronic devices, especially solar cells using Cu2O. He has received his BE degree in Electronics Engineering from KIT in 1987 and his ME and Doctor of Engineering degrees from the KIT in 1989 and 1992, respectively. From 1992 to 1993, he was a Visiting Scientist at the Micro Systems Technology Laboratory at MIT, USA.

tmiyata@neptune.kanazawa-it.ac.jp

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