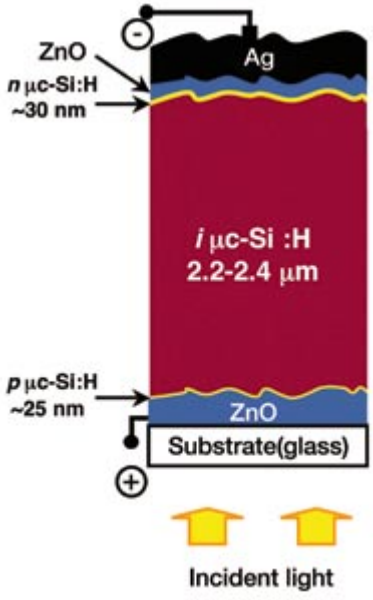
High Rate Plasma Process for High Efficiency Microcrystalline Silicon Solar Cells

Takuya MATSUI
Research Center for Photovoltaics
e-mail: t-matsui@aist.go.jp
AIST Today Vol. 4, No.7 (2004) 13

High-rate deposition technique of hydrogenated microcrystalline silicon (μc-Si:H) light absorber is essentially required for low cost manufacturing of silicon-based thin film solar cells. We have developed a high-rate plasma process based on SiH_4-H_2 glow discharge for highly efficient μc-Si:H *p-i-n* junction solar cells. In high-deposition-rate regime (2-3 nm/s), we observed a remarkable improvement in visible-infrared responses upon increasing deposition pressure (up to 7-9 Torr) under SiH_4-depletion plasma condition, yielding high short circuit current. As a result, a maximum efficiency of 9.13% has been achieved at a deposition rate of 2.3 nm/s. We attribute the improved photovoltaic performance of high-pressure-grown μc-Si:H to the structural evolution toward denser grain arrangement that prevents atmospheric impurity diffusion and post-oxidation of grain boundaries.



Schematic illustration of μc-Si:H single junction *p-i-n* solar cell

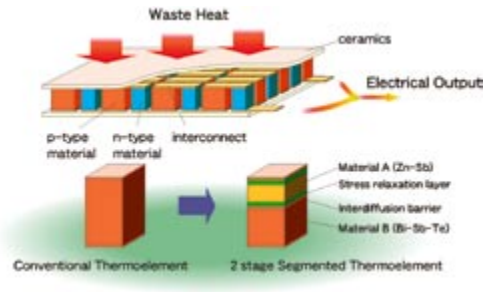
Direct Power Generation from Waste Heat

- Development of lead-free high performance segmented thermoelements -

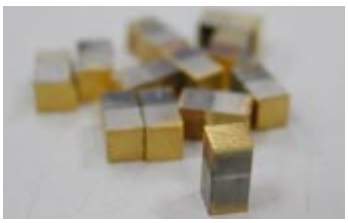
Atsushi YAMAMOTO
Energy Technology Research Institute
e-mail: a.yamamoto@aist.go.jp
AIST Today Vol. 4, No.8 (2004) 14

High performance lead-free p- and n-type segmented thermoelements which are designed to produce electric power at 10% conversion efficiency were developed. The p-type element consists of newly developed zinc-antimony compound (Zn_4Sb_3) and bismuth-antimony-telluride ($(Bi,Sb)_2Te_3$) while the n-type consists of Skutterudite compound ($CoSb_3$) and bismuth telluride (Bi_2Te_3) based material. Zn_4Sb_3 exhibits superior performance over PbTe based material, which has been regarded as the best material for power generation.

A simulation software for thermoelectric power generation has also been developed to accelerate the development of the segmented thermoelements. The software has proven to be a powerful tool for designing thermoelectric modules.



A Schematic drawing of thermoelectric power generation module and a segmented thermoelement



A picture of two stage segmented thermoelements prepared by not pressing