Search for Photo-Seebeck Effect

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Development of an energy technology without environmental pollution is one of the most important subjects for future generations. Solar cell, which converts sunlight energy into electric power through the photovoltaic effect, is a prime example for such technologies. A high conversion efficiency of nearly 20 % is currently available on silicon solar cells. Thermoelectrics is also environmentally friendly energy technology; it can convert heat into electricity via the Seebeck effect in solids. The thermoelectric conversion efficiency is insufficient at present, but new concepts to enhance thermoelectric properties such as phonon glass in filled skutterudite compounds [1], superlattice structure [2], transition-metal oxides [3], and disordered system [4] are proposed beyond the conventional design rules for thermoelectrics.

Here we investigate a correlation between photovoltaic and thermoelectric effects, i.e. photo-Seebeck effect in solids. It was first studied for semiconductor germanium by Tauc [5] and developed in several doped semiconductors [6]. The Seebeck coefficient strongly depends on the injected photon energy and is enhanced under certain conditions. The photo-Seebeck effect is also potentially powerful tool to investigate the electronic band structure [7]. We measure the transport properties in conventional semiconductor *n*-type ZnO under the visible light. The electric conductivity drastically increases in light, indicative of the carrier excitation across the band gap. The Seebeck coefficient is simultaneously measured and its absolute value is decreased from $|S| \sim 600$ μV/K to ~ 100 μV/K with illuminating light, which could be ascribed to a photo doping. This is the first observation of the photo-Seebeck effect in ZnO. The detailed temperature and photon-energy dependence of the photo-Seebeck effects will be discussed.

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