

Semiconductor Materials for High Efficiency Photovoltaic Power Conversion

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The ultimate thermodynamic limit to photovoltaic solar cell efficiency stands at 87% yet, the use of conventional single semiconductor absorbers reduces this value to the standard Shockley-Queisser limit of around 30%. High efficiencies can be recovered using semiconductor junctions by stacking solar cells with different band-gap energies and this approach has resulted in the world record power conversion efficiency of 43.5%. However, in principle high efficiency power conversion can also be obtained from materials that support multiple photon transitions or can sustain hot carrier populations for several nanoseconds. The research status of materials proposed for these various approaches to high efficiency photovoltaic power conversion will be reviewed and presented together with a future outlook.