

**CZTS**  
**MoS<sub>2</sub>**

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Cu<sub>2</sub>ZnSnS<sub>4</sub> (CZTS)  
CuIn<sub>1-x</sub>Ga<sub>x</sub>Se<sub>2</sub> (CIGS)  
10<sup>4</sup>cm<sup>-1</sup> band gap 가  
single junction photovoltaic devices  
crystal morphology CZTS  
layer series resistance  
MoS<sub>2</sub> layer hole barrier recombination  
series resistance 가 MoS<sub>2</sub>  
가 .  
precursor solution-based method CZTS  
sulfurization MoS<sub>2</sub>  
grain size MoS<sub>2</sub> Raman, XRD, SEM , Hall  
measurement MoS<sub>2</sub> . 2-step  
sulfurization CZTS MoS<sub>2</sub>가 370nm 50nm  
grain size가 .