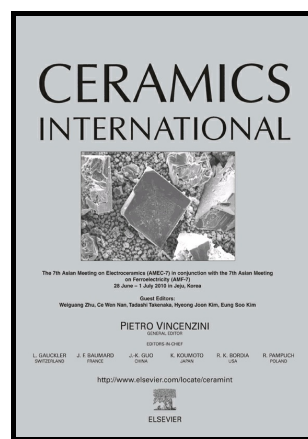


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Synthesis and Investigation of environmental protection and Earth-abundant Kesterite $\text{Cu}_2\text{Mg}_x\text{Zn}_{1-x}\text{Sn}(\text{S,Se})_4$ thin films for Solar Cells

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Abstract

We have synthesized $\text{Cu}_2\text{Mg}_x\text{Zn}_{1-x}\text{Sn}(\text{S,Se})_4$ ($0 \leq x \leq 0.6$) thin films by a facile sol-gel method, and studied the influence of Mg concentration on the crystal structure, surface morphology and photoelectric performance of $\text{Cu}_2\text{Mg}_x\text{Zn}_{1-x}\text{Sn}(\text{S,Se})_4$ thin films systematically. It was shown that the smaller Zn^{2+} in Kesterite phase $\text{Cu}_2\text{ZnSn}(\text{S,Se})_4$ will be replaced by larger Mg^{2+} , forming uniform pure phase $\text{Cu}_2\text{Mg}_x\text{Zn}_{1-x}\text{Sn}(\text{S,Se})_4$. The band gap of $\text{Cu}_2\text{Mg}_x\text{Zn}_{1-x}\text{Sn}(\text{S,Se})_4$ films can be adjusted from 1.12 to 0.88 eV as the x value changes from 0 to 0.6. Furthermore, the $\text{Cu}_2\text{Mg}_x\text{Zn}_{1-x}\text{Sn}(\text{S,Se})_4$ thin films with large grain size, smooth surface and less grain boundaries was obtained at an optimized condition of $x=0.2$. The carrier concentration of $\text{Cu}_2\text{Mg}_x\text{Zn}_{1-x}\text{Sn}(\text{S,Se})_4$ thin film reaches the maximum $6.47 \times 10^{18} \text{ cm}^{-3}$ at $x=0.2$, which is a potential material to be the absorption layer of high efficiency solar cells.

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