

# Accepted Manuscript

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PII: S0925-8388(18)33310-3

DOI: [10.1016/j.jallcom.2018.09.072](https://doi.org/10.1016/j.jallcom.2018.09.072)

Reference: JALCOM 47491

To appear in: *Journal of Alloys and Compounds*

Received Date: 12 June 2018

Revised Date: 6 September 2018

Accepted Date: 8 September 2018

Please cite this article as: T. Wang, Y. Guo, C. Wang, S. Yang, Effects on magnetic properties and light absorption bandgaps of lattice distortions in  $\text{CuIn}_{1-x}\text{Co}_x\text{Se}_2$  chalcopyrites, *Journal of Alloys and Compounds* (2018), doi: <https://doi.org/10.1016/j.jallcom.2018.09.072>.

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# Effects on magnetic properties and light absorption bandgaps of lattice distortions in $\text{CuIn}_{1-x}\text{Co}_x\text{Se}_2$ chalcopyrites

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**Abstract:** Co doped  $\text{CuInSe}_2$  compounds have been synthesized by vacuum arc melting-vacuum solid sintering- mechanical milling technology, and their crystal structures, magnetic and light absorption properties have been systematically investigated by using X-ray diffraction, vibrating sample magnetometer and UV-Vis spectrophotometer. X-ray diffraction analyses show that  $\text{CuIn}_{1-x}\text{Co}_x\text{Se}_2$  ( $x=0-0.2$ ) crystallize in tetragonal chalcopyrite structure with a space group of  $I\bar{4}2d$ . Co partly substitutes for In at the 4b site. The studies of magnetic properties show that  $\text{CuIn}_{1-x}\text{Co}_x\text{Se}_2$  ( $x=0.1-0.3$ ) show supermagnetic characteristics at room temperature with applying an external field. Co doping can adjust the light absorption bandgaps of  $\text{CuIn}_{1-x}\text{Co}_x\text{Se}_2$  from 1.25 to 1.53eV. These phenomena are revealed to be closely correlated with the lattice distortions induced by Co doping into  $\text{CuInSe}_2$ . The magnetism of Co doped  $\text{CuInSe}_2$  is suggested to come from the double-exchange mechanism. The magnetic moment and light absorption bandgap depend upon the lattice distortions of (In,Co)Se<sub>4</sub> and CuSe<sub>4</sub> tetrahedrons, it shows that the magnetic moment is going up with the increase of Se-(In,Co) bond length and the decrease of (In,Co)-Se-(In,Co) bond angle; the light absorption bandgap is going up with the increase of volume distortion of CuSe<sub>4</sub> tetrahedron.

Key word: lattices distortion, double exchange, strong relation

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