

## Syntheses of Cu–In–Ga–Se/S nano particles and inks for solar cell applications

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Nanoparticles of the compound semiconductor, Cu(In, Ga)Se<sub>2</sub> (CIGS), were synthesized in solution under ambient pressure below 100°C and characterized by powder X-ray diffraction (XRD), scanning electron microscopy (SEM), optical absorption spectroscopy and energy-dispersive X-ray (EDX) analyses. These materials have chalcopyrite crystal structures and the particle sizes less than 100 nm. Synthetic conditions were studied for the crystallized CIGS nanoparticles formation to prevent from side products of Cu<sub>2</sub>Se, Cu<sub>2-x</sub>Se, and CuSe etc. The single phase CIGS nanoparticles were applied to coating of thin films photovoltaic cells. The electro deposition of CIGS thin films is also a good non-vacuum technology and under investigation. In aqueous solutions, the different chemical compositions of CIGS thin films were obtained, depending on pH, concentration of starting materials and deposition potentials. The surface morphology of the prepared CIGS thin films depends on the complexing ligands to the solutions during the electrochemical deposition.