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Microstructure, optical and electrical properties of p-type copper iodide thin films

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Copper iodide (CuI) is a p-type semiconducting compound that has turned out to be important in different material studies. The most interesting properties of copper iodide correspond to its high transmittance in the visible range combined with a high electrical conductivity that is close to that of ZnO:Al. Furthermore, CuI is suitable for applications in perovskite solar cells due to its ability to be bonded with many organic and inorganic ligands. Among the different structures of this material, the zinc blende like structure ($F4^{-}3m$) exhibits the best functional properties.
In this work thin films of CuI have been synthesized by the iodination of sputtered Cu thin layers with iodine vapor. We obtained transparent p-type semiconductors films and γ-phase of copper iodide (γ-CuI) with wide bandgap (Eg ≈ 3.1 eV). The structural, electrical, and optical properties of CuI thin films deposited on glass and silicon substrates were studied by XRD, Hall effect, UV-VIS spectrometry, and photoluminescence. We observed that the growth of CuI on highly oriented copper leads to the formation of strongly textured along the [111] direction. As-prepared film shown a resistivity (ρ) of 12.8×10^{-2} Ω cm, hole density (p) of 1.8×10^{20} cm^{-3}, and mobility (μ) of 35.6 cm^2 V^{-1} s^{-1}. As a result, specular transmittance of 48% was set at in averaged visible range. These findings would be used to assist studies in transparent electronics on applications of thin films γ-CuI. Thin-film morphology, examined by SEM, shows a variation of crystal size depending on the elaboration conditions. Crystallographic twin domain in CuI has been observed by using transmission electron microscopy (TEM) and selected area electron diffraction (SAED) through which we can understand the twin geometry and orientation, which are essential for further improving perovskite solar cells.

Keywords
Copper iodide, Sputtering, Semiconductor, Photovoltaic