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In-situ plasma monitoring during pulsed laser deposition of Cu2O thin films and comparison with HiPIMS

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Copper oxide Cu_2O is an important and well known p-type transition metal oxide semiconductor material which has the advantages of direct band gap 2.1 eV and high absorption coefficient in the visible spectral range. In our work we prepared the thin film by means of Pulsed Laser Deposition (PLD) and we compare with those fabricated and reported by means of HiPIMS in literature. The aim of the study was to carried out the Optical emission spectrometry (OES) and generates spatial maps of the main elements of the transient plasmas generated laser ablation. In situ plasma monitoring of the laser produced plasma plays an important role as a feedback and control mechanism in order to adjust the technological processes. OES is the best candidate for plasma monitoring as it is a non-invasive technique and has abilities for quantitative and qualitative analyses. PLD of the a ceramic CuO and metal Cu targets was performed on a wide range of O_2 pressures (from 10^{-3} up to 20 Pa) in order to achieve stoichiometric transfer and tailor the properties of the thin films. During the deposition process, the optical emission of the plasma was recorded using a 10 linear bundle full range optical fibre connected to high resolution spectrometer. The fibre was positioned at various distances with respect to the target in order to extract the spatial distribution of the species within then plasma volume. Using a specialized database, we identified emission lines for both Cu atoms and ions and only O ions. Using the Boltzmann approach from we determined the global excitation temperature, the electron density was also estimated using the stark broadening approach. The results are compared with the properties of the deposited thin films determined by surface analysis techniques like, AFM, SEM, XPS, Raman Spectroscopy or XRD.

Keywords
Optical emission spectroscopy
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laser plasma