PhD defense « Growth and characterization of Cuprous Oxide Absorbers for Photovoltaics »

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The PhD thesis defense of Chithira Venugopalan Kartha entitled "Growth and characterization of Cuprous Oxide Absorbers for Photovoltaics" took place on Monday 12 December 2022 in Strasbourg.

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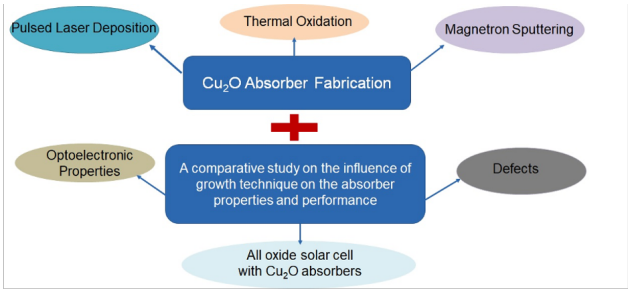
Summary

Cuprous Oxide (Cu_2O) is a promising candidate as an absorber in photovoltaics. In this work, initially we have optimized the deposition conditions for pure Cu_2O film without any parasitic CuO phase via Pulsed Laser Deposition (PLD) and RF Magnetron Sputtering. Optimization of the thermal oxidation of copper sheets to obtain Cu_2O was also carried out. We have shown that the stoichiometry of the film can be controlled by varying the deposition conditions. The absorber properties of the films were investigated in detail with several structural, optical, and electrical characterization techniques. To study the influence of the Cu_2O growth technique on the absorber properties, optimised PLD and sputtered Cu_2O films were compared to thermally oxidised Cu_2O sheets. The photovoltaic response of the same absorber prepared via different techniques was also investigated by constructing solar cells with suitable heterojunctions.



Focus of the PhD thesis of C. Venugopalan Kartha

An open-circuit voltage of 0.56 V was measured from epitaxially grown PLD Cu_2O with Nb:$SrTiO_3$ heterojunction. The highest current was obtained for solar cell with thermally oxidised sheet with a short-circuit current density of 1.90 mA/cm^2. The sputtered Cu_2O solar cell also showed promising photovoltaic response. Finally, the variation in the absorber efficiency of Cu_2O was analysed using advanced characterization techniques such as Transient Absorption and Time-Correlated Single Photon Counting. The presence of defects or traps were found to influence the carrier lifetime in the PLD and sputtered Cu_2O films, highly affecting the charge carrier separation efficiency when employed in a photovoltaic cell.