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Yb^{3+} doped SnO_x thin films by reactive magnetron sputtering as functionalized TCOs for solar cells

K. Bouras[1*], D. Aureau[2], G. Schmerber[3], H. Rinnert[4], G. Ferblantier[1], S.colis[3], T.Fix[1], A. Dinia[3] and A. Slaoui[1]

1 ICube, CNRS-Université de Strasbourg, UMR 7357, 23 rue du Loess, 67037 Strasbourg
2 ILV, Université de Versailles-St-Quentin en Yvelines, UMR 8180, 45 avenue des Etats Unis, 78000 Versailles,
3 IPCMS, CNRS-Université de Strasbourg UMR 7504, 23 rue du Loess, 67034 Strasbourg, France
4IJL, Université de Lorraine-CNRS, UMR 7198, Boulevard des Aiguillettes, 54506 Vandœuvre-l`es-Nancy
Contact e-mail : k.bouras@unistra.fr

RÉSUMÉ

SnO_2 as a standard TCO material have recently attracted special attention, thanks to the particular dual valency of tin and to the reversible transformation of the material that can occurs from p-type SnO to n-type SnO_2 with excellent transport properties. Besides, SnO_2 can be functionalized with Rare Earth elements (RE), which gives rise to new properties. In the field of solar cells, this class of materials can be used as conversion layer to adapt the incident solar spectrum to the solar cell absorption, reducing the losses due to carriers' thermalization.
In this work we present properties of SnO_2 films doped with Yb (1.30 at.%) and elaborated by reactive magnetron sputtering. The films were elaborated at 100°C for the sake of compatibility with low temperature used for devices fabrication. The XRD analysis showed structural change in the polycrystalline SnO_2 films as a function of the oxygen gas flow during elaboration. We gain better insight into the oxides proportions through chemical analysis by XPS spectroscopy. Yb ions are well inserted in the structure and possess the 3+ valence state. Analysis by PL spectroscopy shows that under UV excitation of 325 nm, the SnO_2: Yb films exhibit a wide and intense emission lines in the infrared region characteristic Yb^{3+} ions. The Yb-related PL was correlated to the SnO_2 phase. Thanks to PLE measurements, an efficient energy transfer from the SnO_x host matrix to the Yb rare earth has been identified. The films exhibit transparency laying between 80-90% with excellent transport properties, resistivities as low as 0,006 Ohm.cm and mobilities as high as 50.16 $cm^2/V.s$ were measured. Such optical and electrical results are of potential interest to solar cells using Yb doped SnO_2 films as TCO and photon down shifter.

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Mots Clés : *Rare earth elements, transparent conductive oxide, tin oxide, ytterbium, silicon, solar cells*