InO_x THIN FILMS DEPOSITED BY PLASMA ASSISTED EVAPORATION: APPLICATION IN LIGHT SHUTTERS

A.Amaral [a, b], E.Merino [e], G.Lavareda [c,d], C.Nunes de Carvalho [a,c], P.Almeida [e,f]

[a] Instituto de Ciência e Engenharia de Matéria e Superfícies - ICEMS, [b]Departamento de Física, Instituto Superior Técnico - IST, Universidade de Lisboa – UL, Av. Rovisco Pais 1, 1049–001 Lisboa, Portugal; [c] Departamento de Ciência dos Materiais, FCT-UNL, 2825–114 Caparica, Portugal; [d] CTS, FCT-UNL, 2825–114 Caparica, Portugal; [e] I3N-CENIMAT, Faculdade de Ciências e Tecnologia - Universidade Nova de Lisboa, Campus da Caparica, 2829 – 516 Caparica, Portugal; [f] Área Departamental de Física, ISEL - Instituto Superior de Engenharia de Lisboa, Rua Conselheiro Emídio Navarro 1,1959-007 Lisboa, Portugal

ana.de.amaral@ist.utl.pt

Abstract

Undoped transparent conductive InO_x thin films (TCO), of about 100 nm thick, are deposited by radiofrequency plasma enhanced reactive thermal evaporation (rf-PERTE) of indium teardrops with no intentional heating of the glass substrates. The process of deposition occurs at very low deposition rates (0.1-0.3 nm/s) to establish an optimized reaction between the oxygen plasma and the metal vapor. These films show the following main characteristics: transparency of 87 % (wavelength, λ = 632.8 nm) and electrical resistivity of 6×10^{-4} Ωcm comparable with the ones measured for the commercial TCO [1]. AFM studies showed films with different roughness which influenced the electrical optical properties of the micro and nano fiber based light shutters devices. A preliminary integration of these InO_x films into laboratory assembled light shutters, produced with cellulosic micro/nano fibers and a nematic liquid crystal, gave rise to electro-optical properties similar to those of devices assembled using commercially available TCO's such as ITO films [2]. For the shutters assembled using commercial ITO, the light transmission coefficient (Tr) reaches the highest value (Tr_{max}) of 89% and the lowest (Tr_{min}) of 1.3%, while for the InO_x shutters these values are 80% and 3%, respectively. Regarding the electric field required to achieve 90% of the maximum transmission in the ON state (E_{on}) the one presented by the devices assembled with commercial ITO coated glasses is 2.4 V/µm while the one presented by the devices assembled with InO_x coated glasses is smaller, 1.77 V/µm. These results corroborate the device quality that depends on the base materials and fabrication process used.

References

[1] P.L.Almeida, G.Lavareda, C. Nunes de Carvalho, A.Amaral, M.H.Godinho, M.T.Cidade and J.L. Figueirinhas, Liquid Crystal, (2002), 29, 3, 475-477.

[2] P.L. Almeida, S. Kundu, J.P. Borges, M.H. Godinho and J.L. Figueirinhas Appl. Phys. Lett. 95 (2009) 043501.