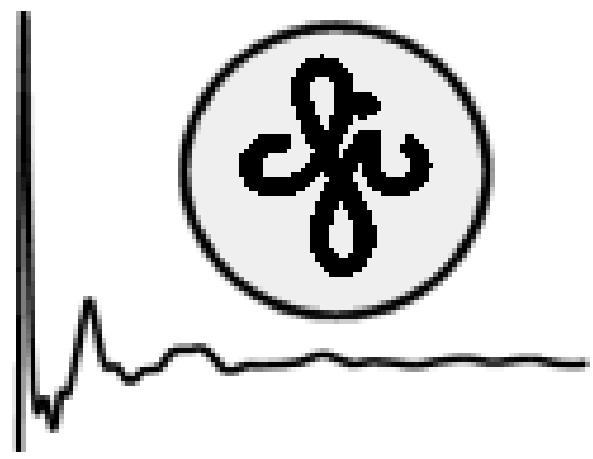


DC magnetron deposition of Zn-based TCO-s: process control by plasma optical emission spectroscopy

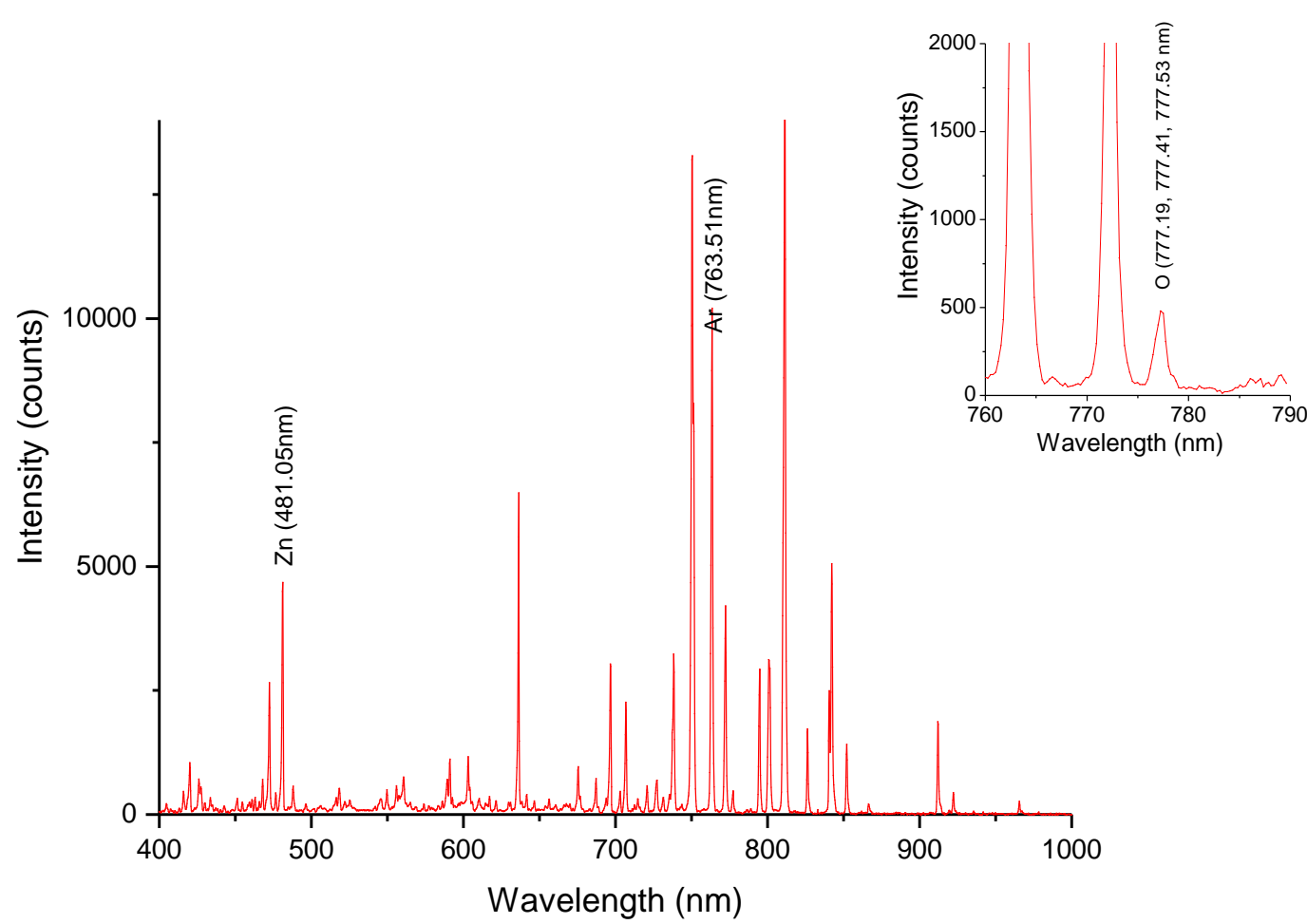


R.Kalendarev, K.Vilnis, A.Ecis, M.Zubkins, A.Azens, J.Purans
Institute of Solid State Physics, University of Latvia, Riga, Latvia

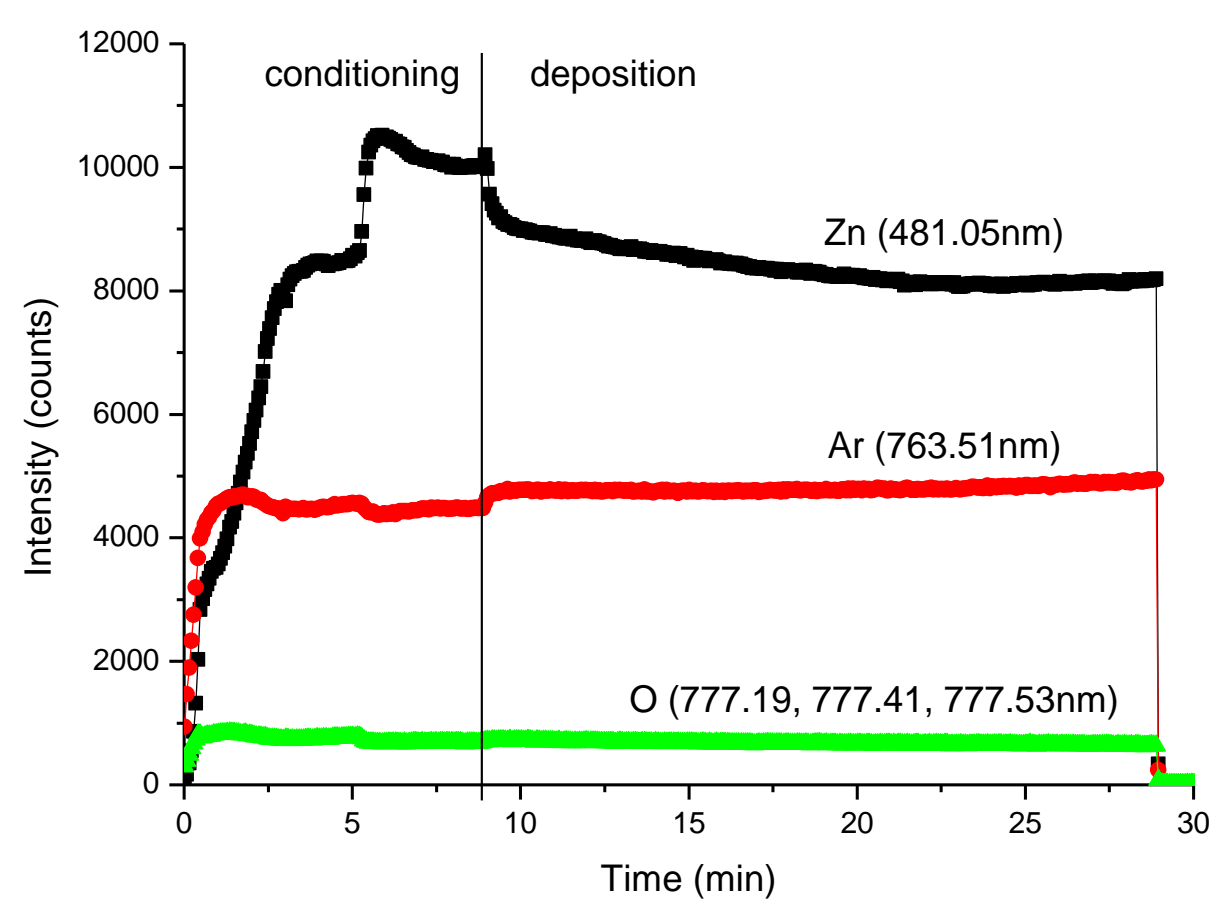


The scope: the usefulness of plasma Optical Emission Spectroscopy (OES) for the sputtering process tuning has been investigated with the aim to ensure the process stability and reproducibility, and the quality of ZnO:Al films in terms of [minimized] electrical resistivity and [maximized] optical transmittance

The approach:



Optical emission spectrum upon sputtering of a ZnAl target in an atmosphere of Argon and Oxygen

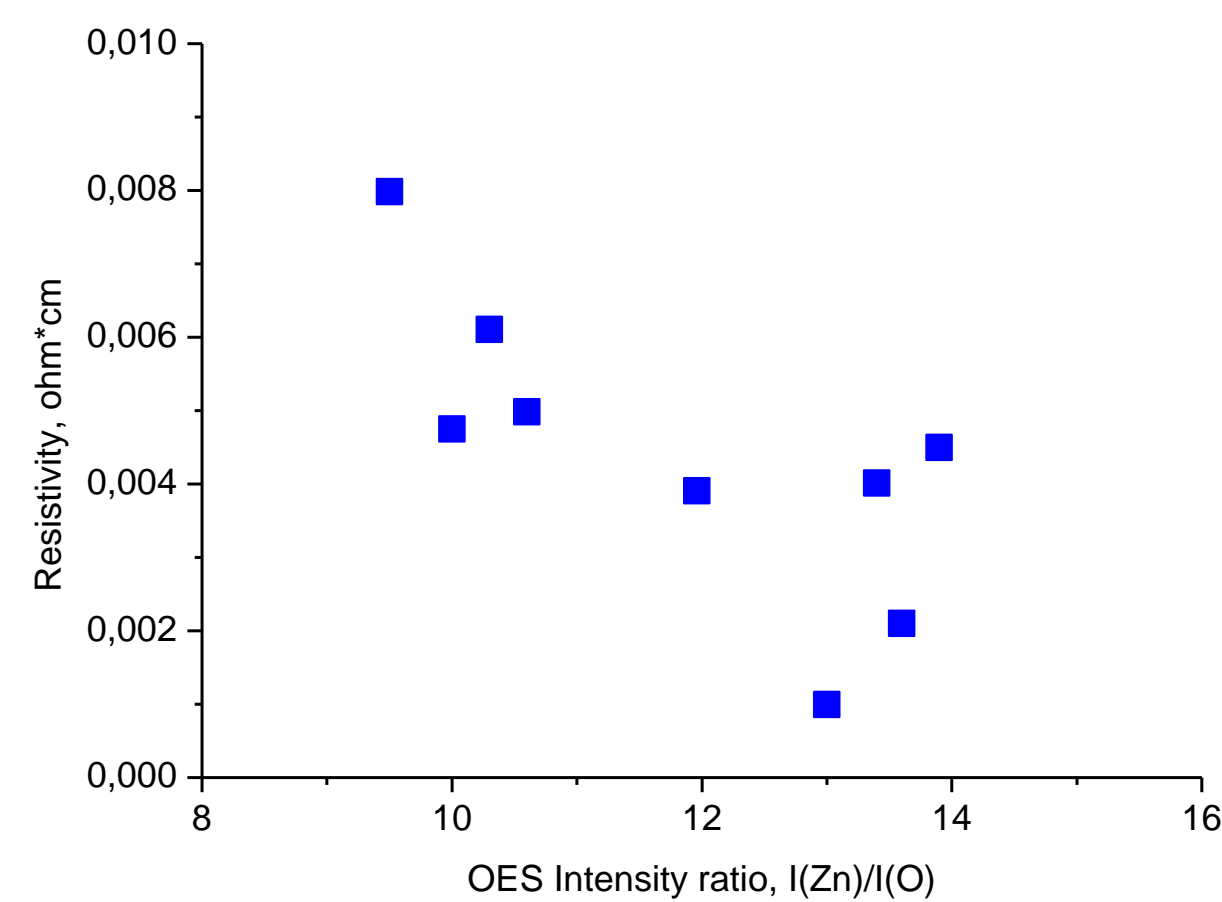


Selected Zinc, Argon and Oxygen optical emission line intensities during the process conditioning and film deposition

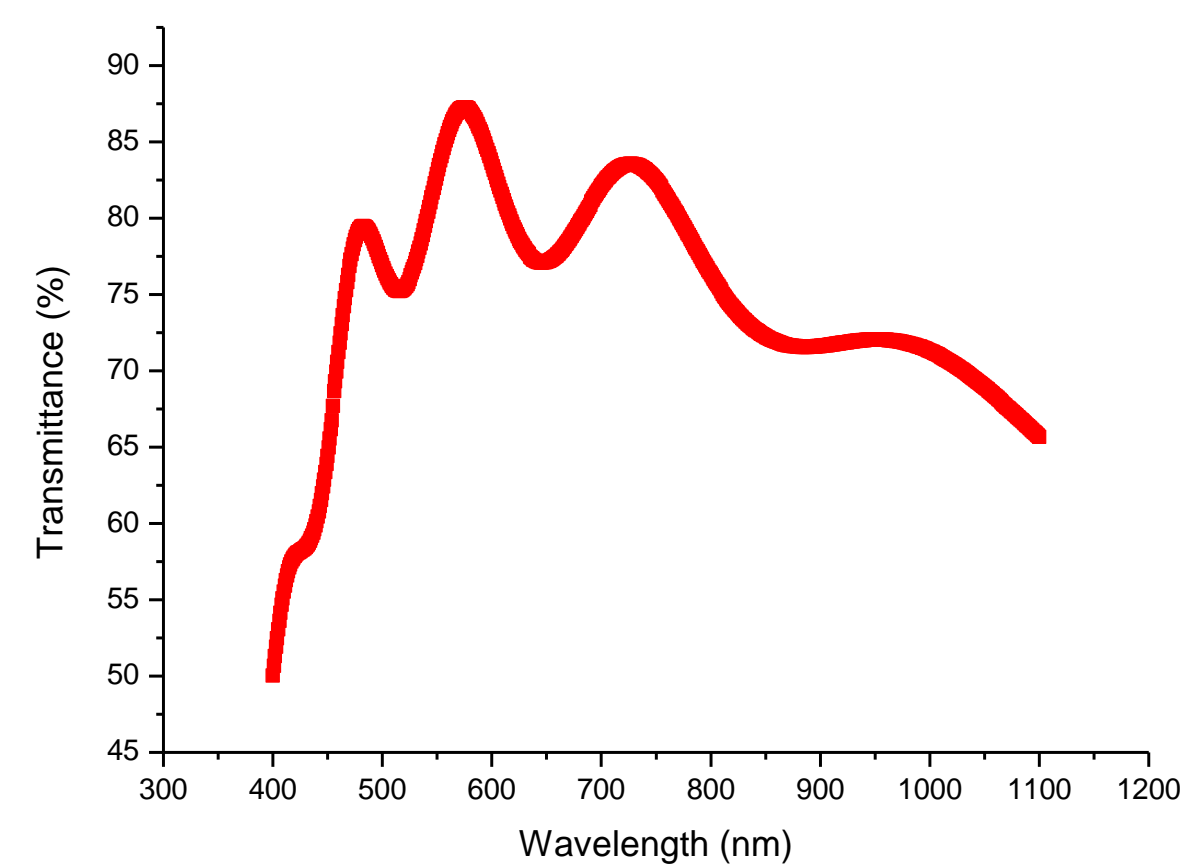
For comparison:

Film	Resistivity (ohm×cm)	Reference
ZnO	9.8×10^{-1}	Bian et al. <i>Appl.Phys.Lett.</i> , Vol 85, No 18, 2004
ZnO	1×10^{-2}	Xiu et al. <i>Appl.Phys.Lett.</i> , Vol 87, No 15, 2005
ZnO:N (p type)	3.02×10^{-2}	Bian et al. <i>Appl.Phys.Lett.</i> , Vol 85, No 18, 2004
ZnO:Ga, varied Ga content	$1.4 \times 10^{-4} - 2.5 \times 10^{-3}$	Bhosle et al. <i>J.Appl.Phys</i> 100, 033713, 2006
ZnO:Al	2.7×10^{-4}	T.Minami, <i>Semicond.Sci.Technol.</i> 20, 2005
ZnO:Al	2.7×10^{-3}	Kelly et al. <i>Thin Solid Films</i> , 426, 2003

The results:



Resistivity for ZnO:Al films deposited at different Zinc and Oxygen optical emission line intensity ratios



Optical transmittance spectrum for a ZnO:Al film deposited at OES Intensity ratio $I(\text{Zn})/I(\text{O}) \approx 12$

The Conclusion:

although the film resistivity data is not completely free from scattering [yet], the correlation between the values of the OES line intensities upon film deposition and the film properties confirms the usefulness of OES for the deposition process control of ZnO:Al films

Acknowledgements

The work has been performed within the ERAF Projects
2010/0272/2DP/2.1.1.1.0/10/APIA/VIAA/088.