SUPPORTING INFORMATION

ALD of ZnO:Ti : growth mechanism and application as efficient transparent conductive oxide in silicon nanowire solar cells

Damien Coutancier,[1,2] Shan-Ting Zhang,[1,2] Simone Bernardini,[1,3] Olivier Fournier,[1,4] Tiphaine Mathieu-Pennober,[5] Frédérique Donsanti,[1,4] Maria Tchernycheva,[5] Martin Foldyna,[6] Nathanaelle Schneider[,1,2]*

[1] Institut Photovoltaïque d'Ile-de-France (IPVF), 18 boulevard Thomas Gobert, 91120 Palaiseau, France

[2] CNRS, UMR 9006, Institut Photovoltaïque d'Ile-de-France (IPVF), 18 boulevard Thomas Gobert, 91120 Palaiseau, France

[3] TOTAL, 18 boulevard Thomas Gobert, 91120 Palaiseau, France

[4] EDF R&D, IPVF, 18 boulevard Thomas Gobert, 91120 Palaiseau, France

[5] Centre de Nanosciences et de Nanotechnologies, UMR 9001 CNRS, Univ. Paris-Saclay, 10 Boulevard Thomas Gobert, 91120 Palaiseau Cedex, France.

[6] LPICM, CNRS, Ecole Polytechnique, IP Paris, 91128 Palaiseau, France

Corresponding Author

*E-mail: n.schneider@cnrs.fr (N. Schneider)

Figure S1. Influence of the precursor introduction on the structural properties of ALD-TZO films (sequence A : {ZnO} = H_2O pulse / N_2 purge / DEZ pulse / N_2 purge ; sequence B {ZnO} = DEZ pulse / N_2 purge / H_2O pulse / N_2 purge ; n = 44 ; n_1 = 10) and ZnO würtzite reference diffraction pattern (JCPDS 36-1451)

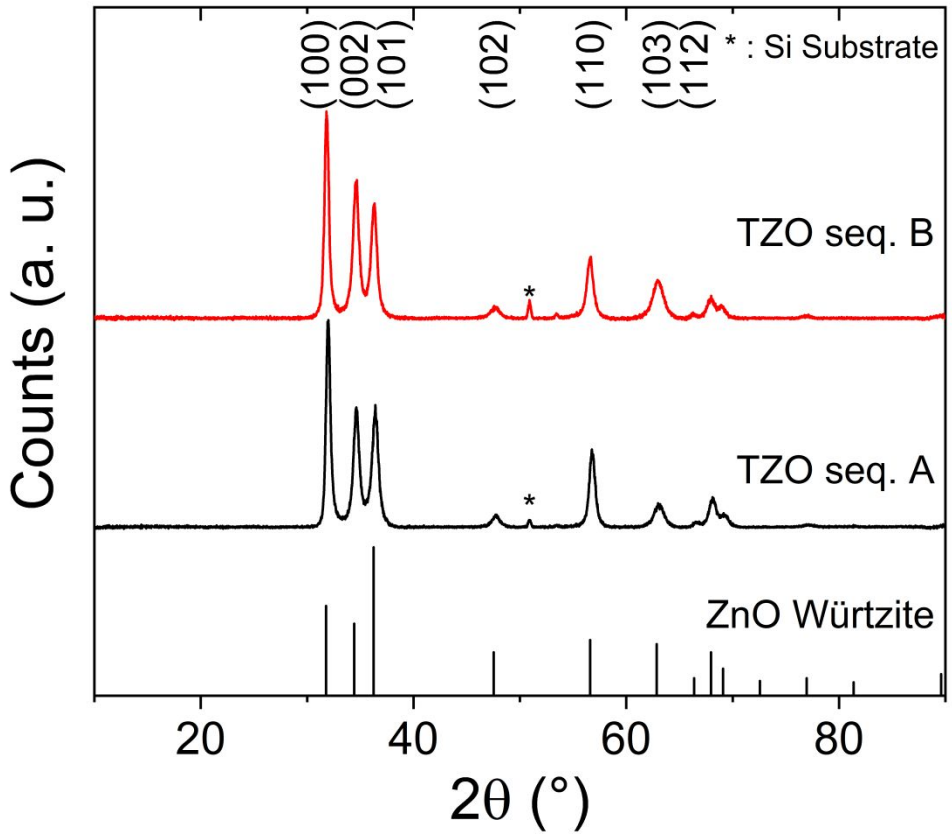
(100)
(002)
(101)
(102)
(110)
(103)
(112)
* : Si Substrate
TZO seq. B
TZO seq. A
ZnO Würtzite
Counts (a. u.)
20
40
60
80
2θ (°)

Figure S2. Influence of the cycle ratio {TiO_2}:{ZnO} on the TZO film thickness as determined by ellipsometry (full triangle) and XRR (cross) (sequence A, n = 22 - 445). The thickness values expected from the linear combination of GPC_{TiO2} and GPC_{ZnO} are presented by circles. The GPC values (GPC_{TiO2}, GPC_{ZnO}) have been calculated from film thicknesses determined by XRR.

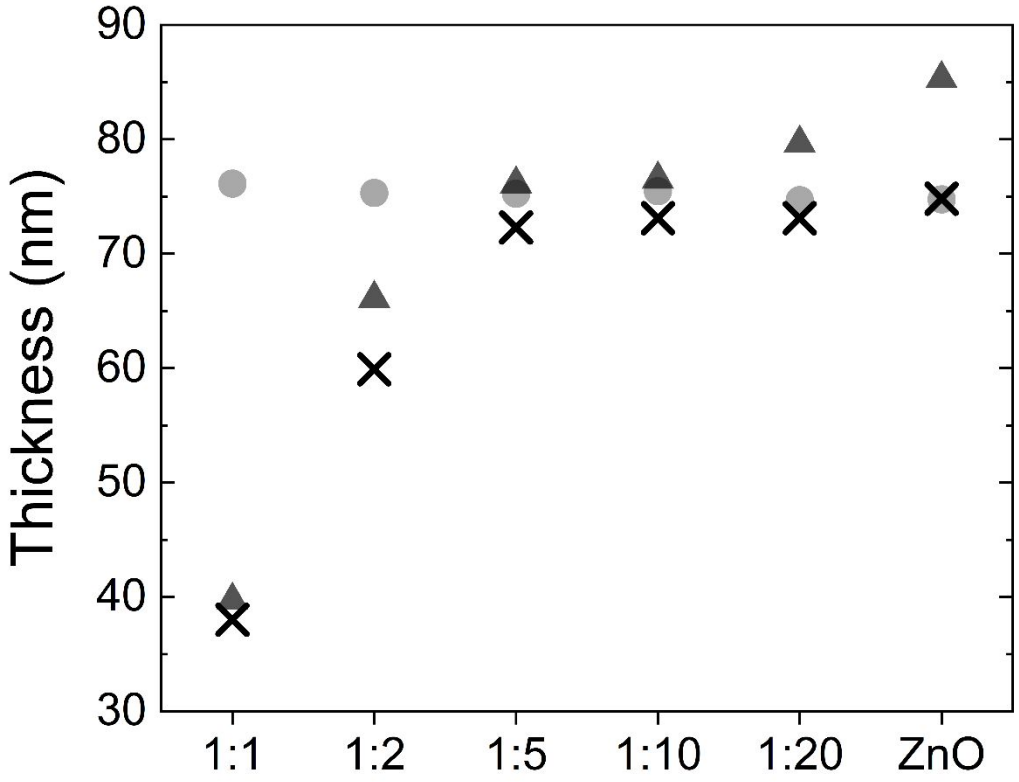

Figure S3. Influence of the cycle ratio {TiO_2}:{ZnO} on the TZO structural properties (sequence A, n = 22 - 445) and reference diffraction patterns of $ZnTiO_3$ (JCPDS 26-1500), ZnO würtzite (JCPDS 36-1451), and anatase TiO_2 (JCPDS 20-1272)

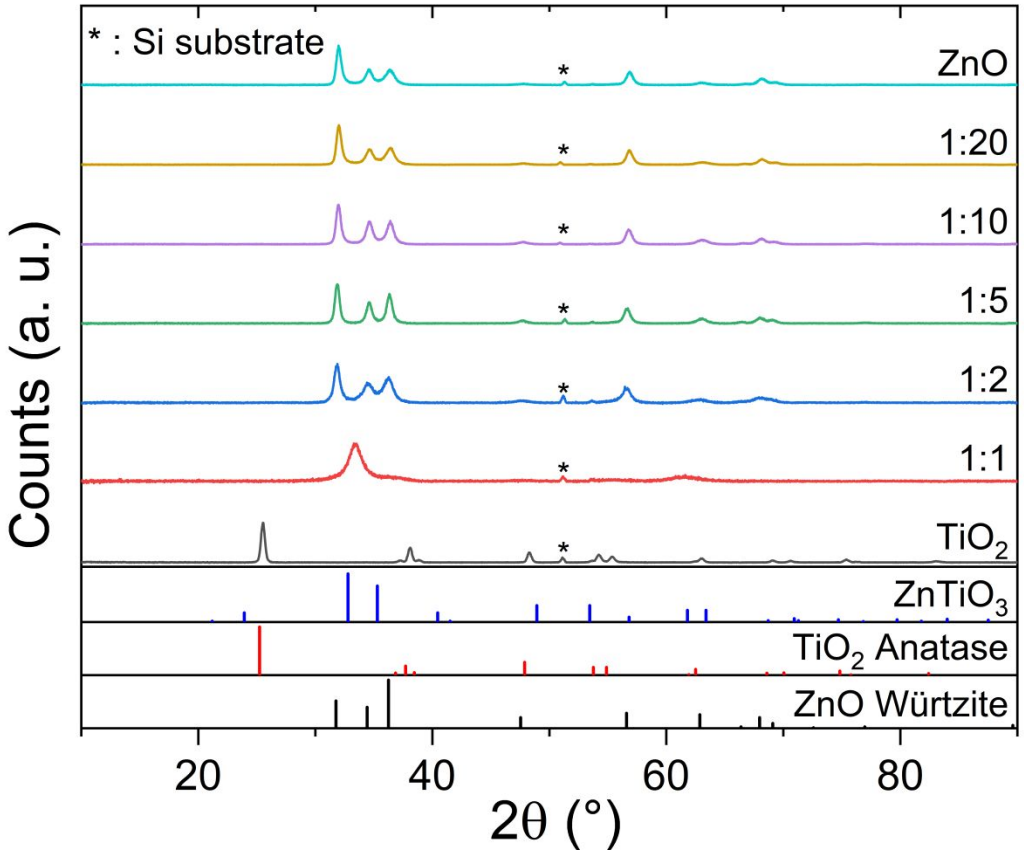

Figure S4. Influence of the cycle ratio {TiO_2}:{ZnO} on the TZO optical properties (sequence A, n = 22 - 445, transmission (solid lines, in %), reflection (dotted lines, in %)

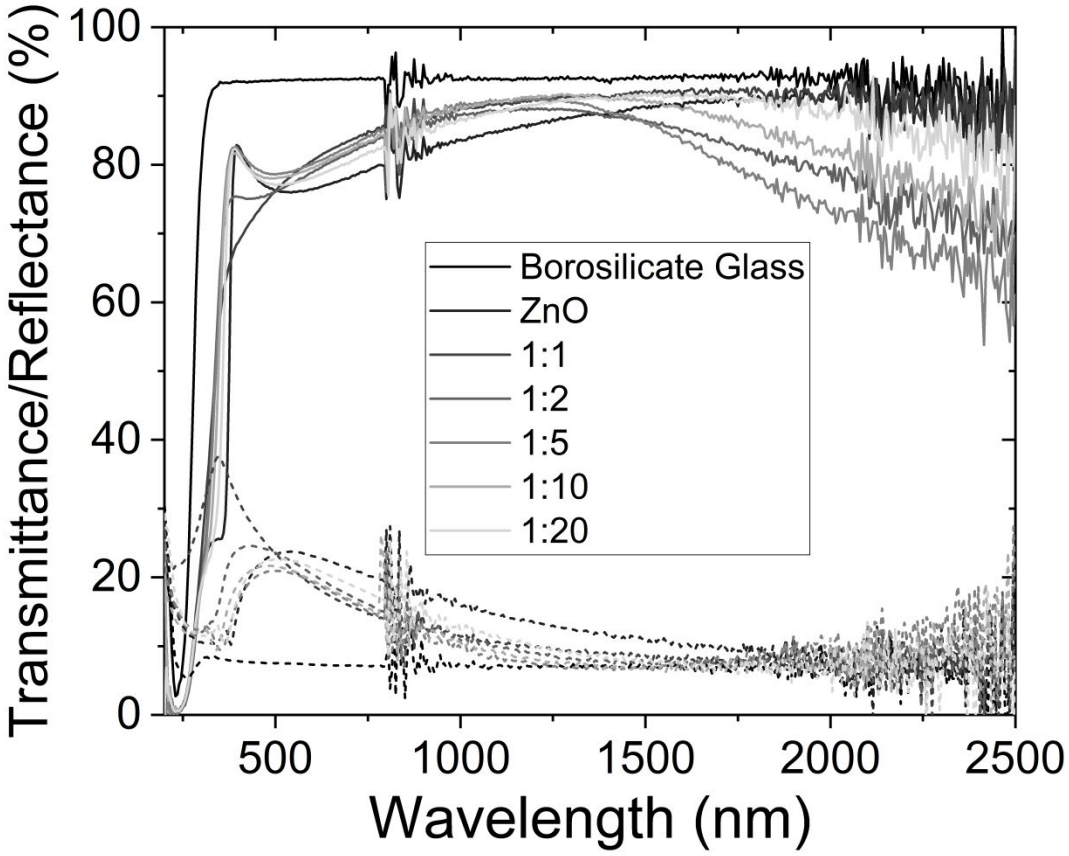

Figure S5. Influence of the cycle ratio {TiO_2}:{ZnO} on the TZO index of refraction *n* at 633 nm

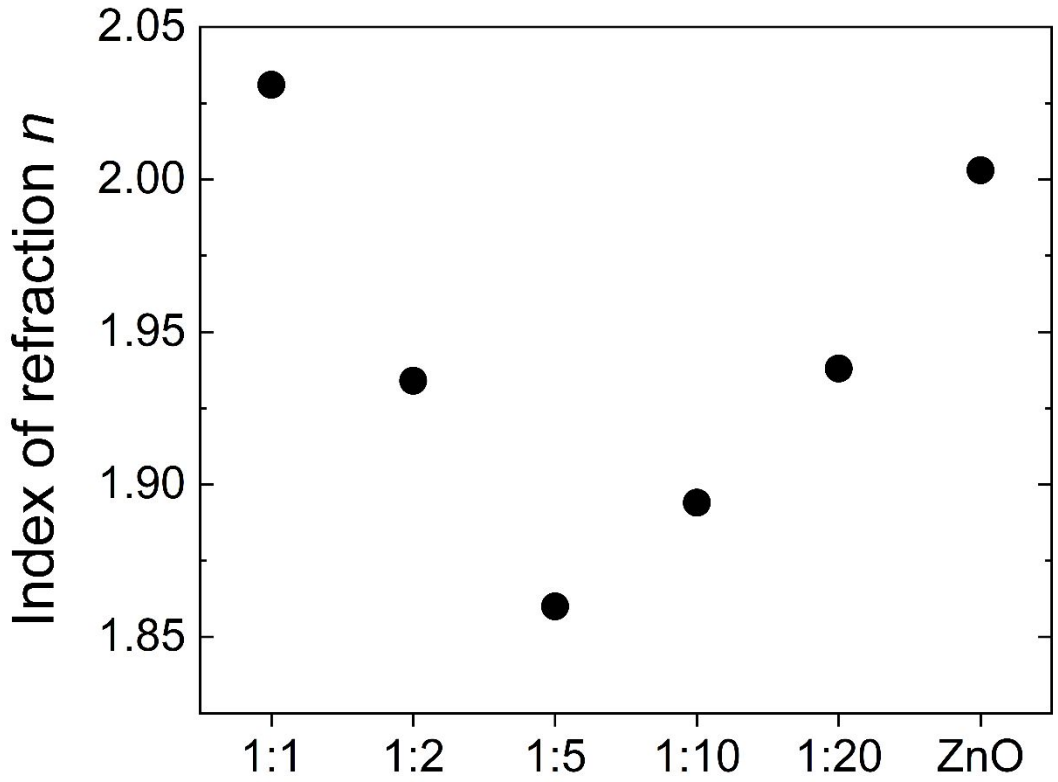

Figure S6. Influence of the cycle ratio $\{TiO_2\}$:{ZnO} on the TZO electrical properties : carrier concentration (diamonds, in cm^{-3}), mobility (squares, in $cm^2/V \cdot s$) and resistivity (triangles, in $\Omega \cdot cm$) (sequence A, n = 22 - 445)

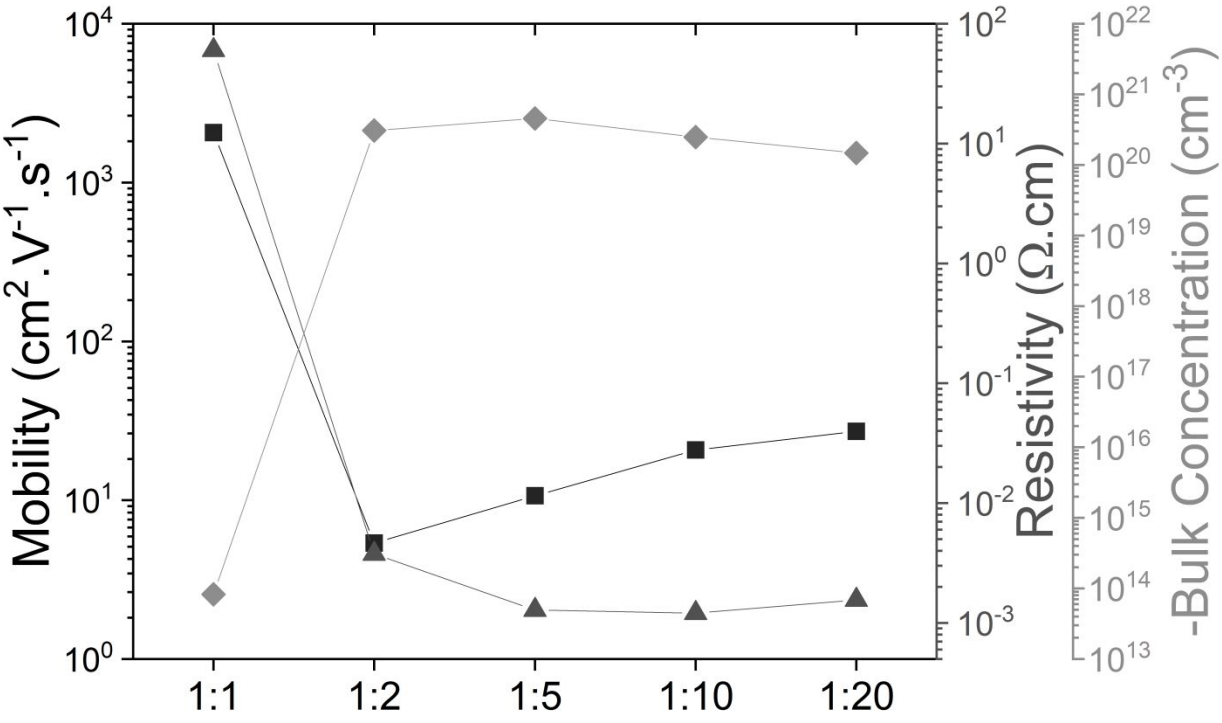

Figure S7. Influence of the film thickness on the TZO structural properties (sequence A, n_1 = 10) and reference diffraction patterns of ZnO würtzite (JCPDS 36-1451), and anatase TiO_2 (JCPDS 20-1272)

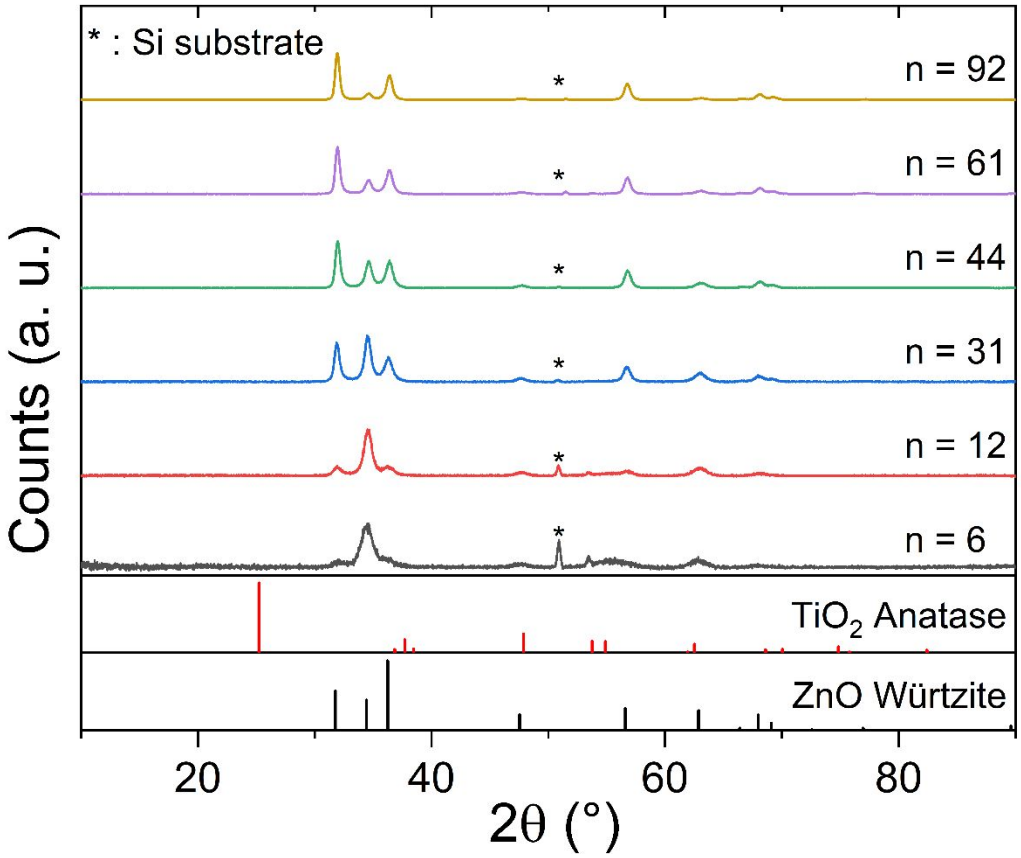

Figure S8. Influence of the film thickness on the TZO optical properties (sequence A, n_1 = 10, transmission (solid lines, in %), reflection (dotted lines, in %)

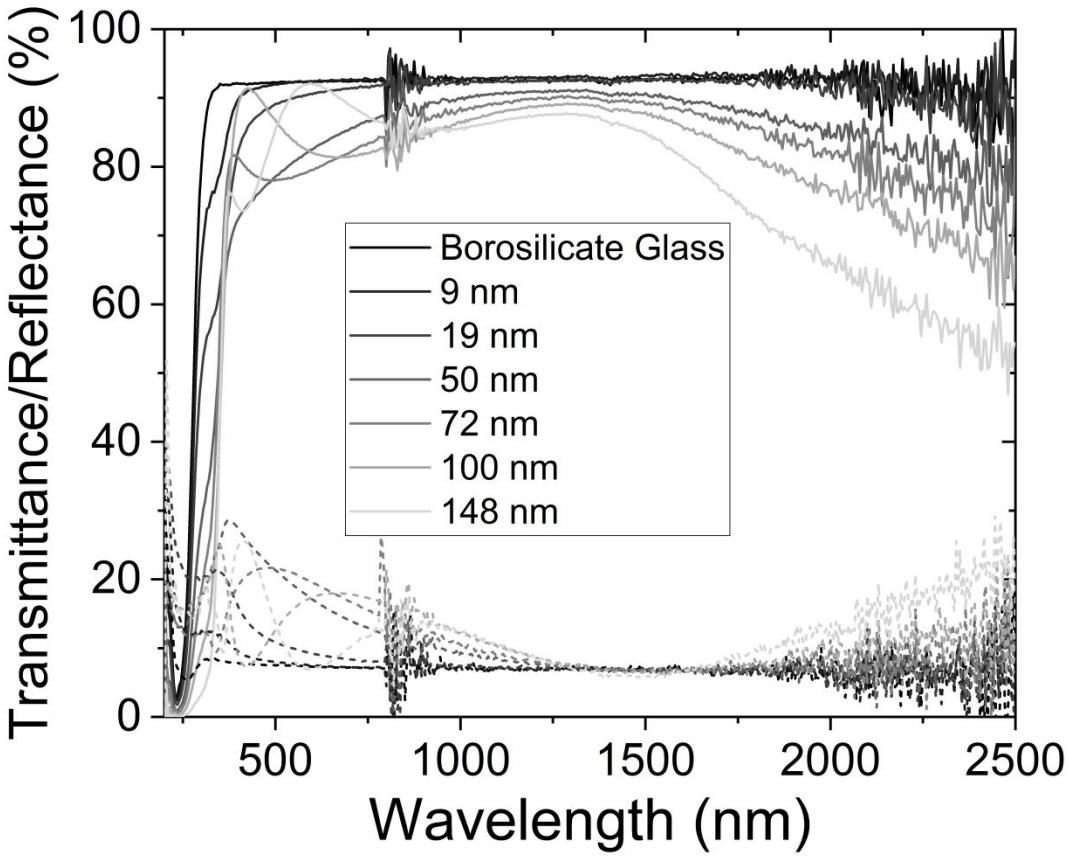

Figure S9. Influence of the film thickness on the TZO electrical properties: carrier concentration (diamonds, in cm^{-3}), mobility (squares, in $cm^2/V \cdot s$) and resistivity (triangles, in $\Omega \cdot cm$) (sequence A, $n_1 = 10$).

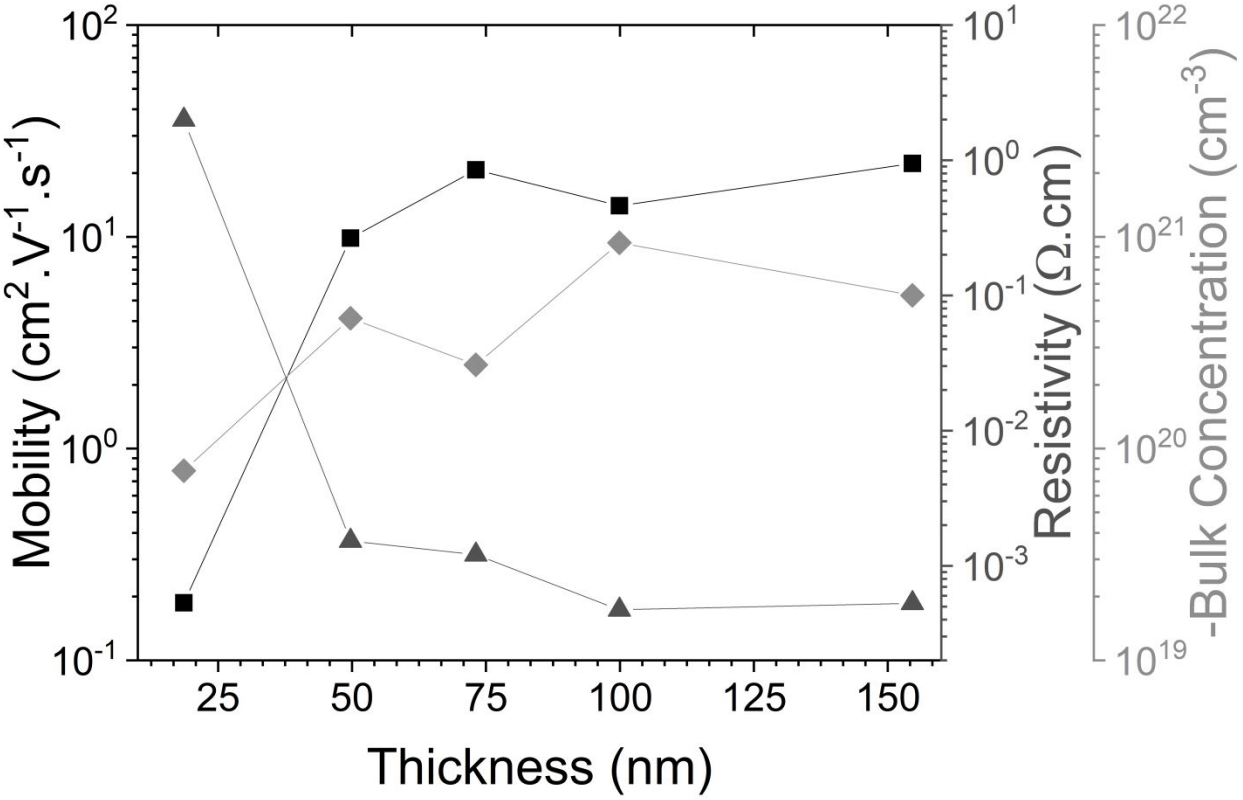

Figure S10. Cross sectional SEM image of the radial NW structure with ITO top electrode (by sputtering).