

Supporting information for

Nanostructural ZnO doped with Ti for dye-sensitized solar cellsMati Ur Rahman ^{a,b}, Mingdeng Wei ^{*a,b}, Fengyan Xie ^{a,b}, Matiullah Khan^{*c}^a State Key Laboratory of Photocatalysis on Energy and Environment, Fuzhou University, Fuzhou, Fujian 350002, China;^b Institute of Advanced Energy Materials, Fuzhou University, Fuzhou, Fujian 350002, China.^c Department of Physics, Kohat University of Science and Technology, Kohat 26000, Pakistan.

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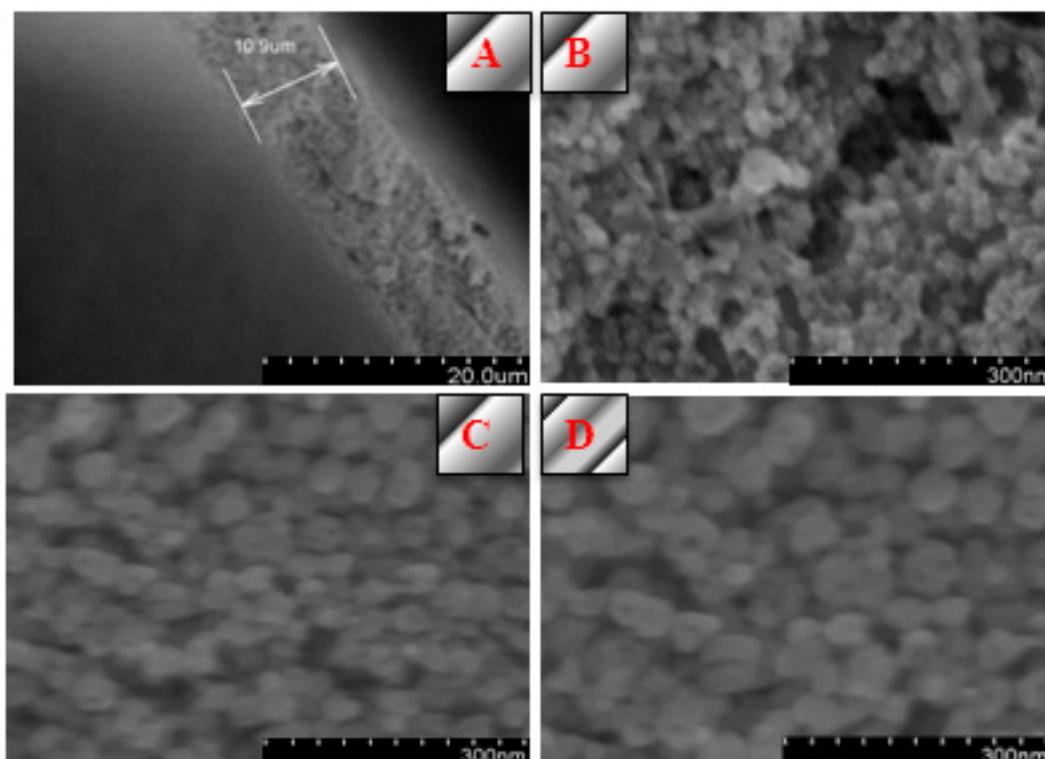


Figure S1 SEM images of ZnO and Ti doped ZnO, film thickness (A), ZnO stretched cell (B), Ti doped ZnO stretched and fresh cell (C, D).

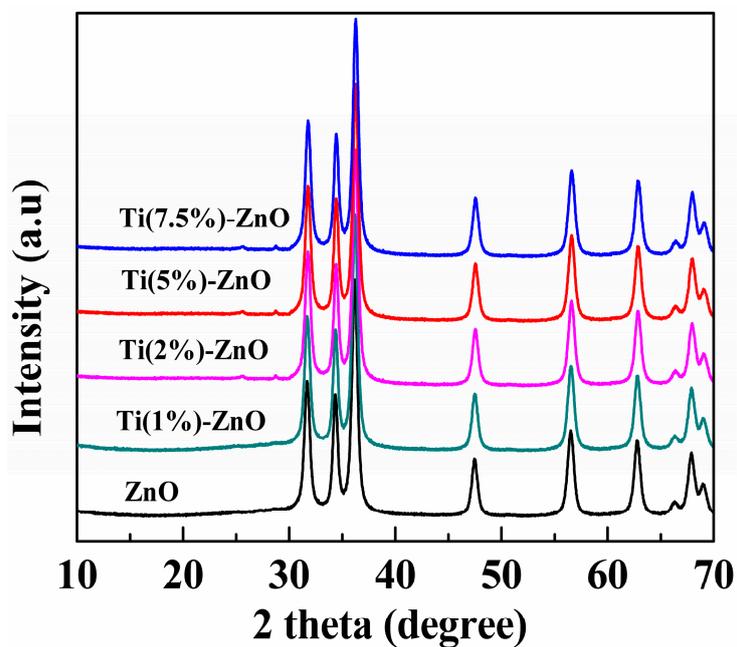


Figure S2 X-ray diffraction patterns of ZnO and Ti doped ZnO, with various percentage of Ti doping.

Table S1 Physiochemical properties of ZnO and TZ materials

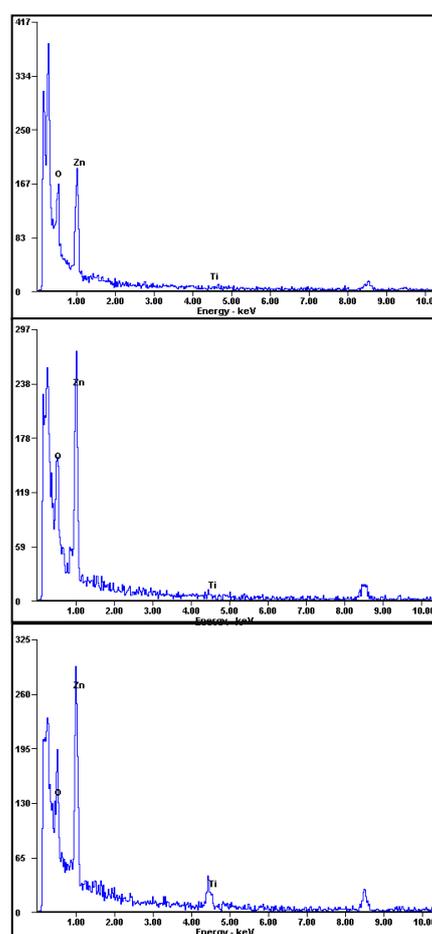
Samples	BET surface area [m^2/g]	Vol [cm^3/g]	Crystallite size(nm)	Lattice strain %
ZnO	45.35	0.198	21.3	0.670
Ti-7.5%	131.85	0.577	18.2	0.787
ZnO				

Table S2 Elemental analysis of Ti percentage in TZ samples

S/No	Samples name	Titanium (%)		
		Calculated	Observed ^a	Observed ^b
1	Ti(1%)-ZnO	1.0	0.96	0.93
2	Ti(2%)-ZnO	2.0	1.84	1.78
3	Ti(5%)-ZnO	5.0	4.71	4.84
4	Ti(7.5%)-ZnO	7.5	7.23	7.41

Figure S3 EDX of TZ samples (1, 2, 3 and 4)

<i>Element</i>	<i>Wt%</i>	<i>At%</i>
<i>OK</i>	39.27	72.36
<i>ZnL</i>	59.8	27.11
<i>TiK</i>	00.93	00.53
<i>Matrix</i>	Correction	ZAF
<i>Element</i>	<i>Wt%</i>	<i>At%</i>
<i>OK</i>	39.01	72.36
<i>ZnL</i>	59.21	26.70
<i>TiK</i>	01.78	00.94
<i>Matrix</i>	Correction	ZAF
<i>Element</i>	<i>Wt%</i>	<i>At%</i>
<i>OK</i>	36.27	70.63
<i>ZnL</i>	58.89	26.70
<i>TiK</i>	4.84	02.67
<i>Matrix</i>	Correction	ZAF
<i>Element</i>	<i>Wt%</i>	<i>At%</i>
<i>OK</i>	34.13	66.36
<i>ZnL</i>	58.46	27.41
<i>TiK</i>	7.41	06.23
<i>Matrix</i>	Correction	ZAF



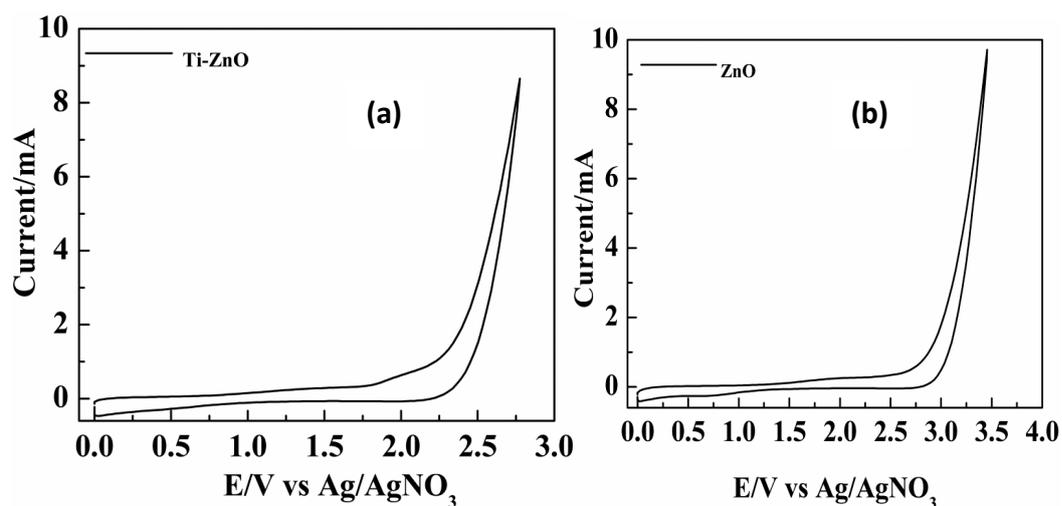


Figure S4 CVs of (a) Ti-ZnO and (b) ZnO

Table S3 Optical and electrochemical properties of ZnO and Ti-ZnO

Sample	λ (nm)	E_g (eV)	$E_{ox}(\text{ferrocene})$ (V)	E_{ox} (v)	HOMO (eV)	LUMO (eV)
ZnO	399	3.10	0.45	2.93	-7.28	-4.18
Ti5%-ZnO	405	3.02				
Ti7.5%-ZnO	426	2.91	0.45	2.27	-6.62	-3.71

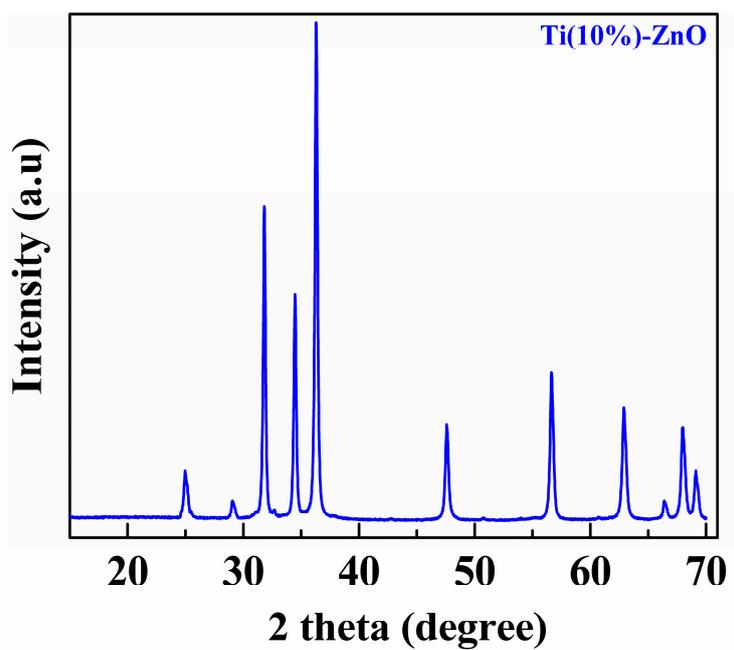


Figure S5 X-ray diffraction pattern of Ti(10%)-ZnO