Electronic Supplementary Information

Role of Crystallinity of the Nb_2O_5 Blocking Layer on the Performance of Dye-sensitized Solar Cells

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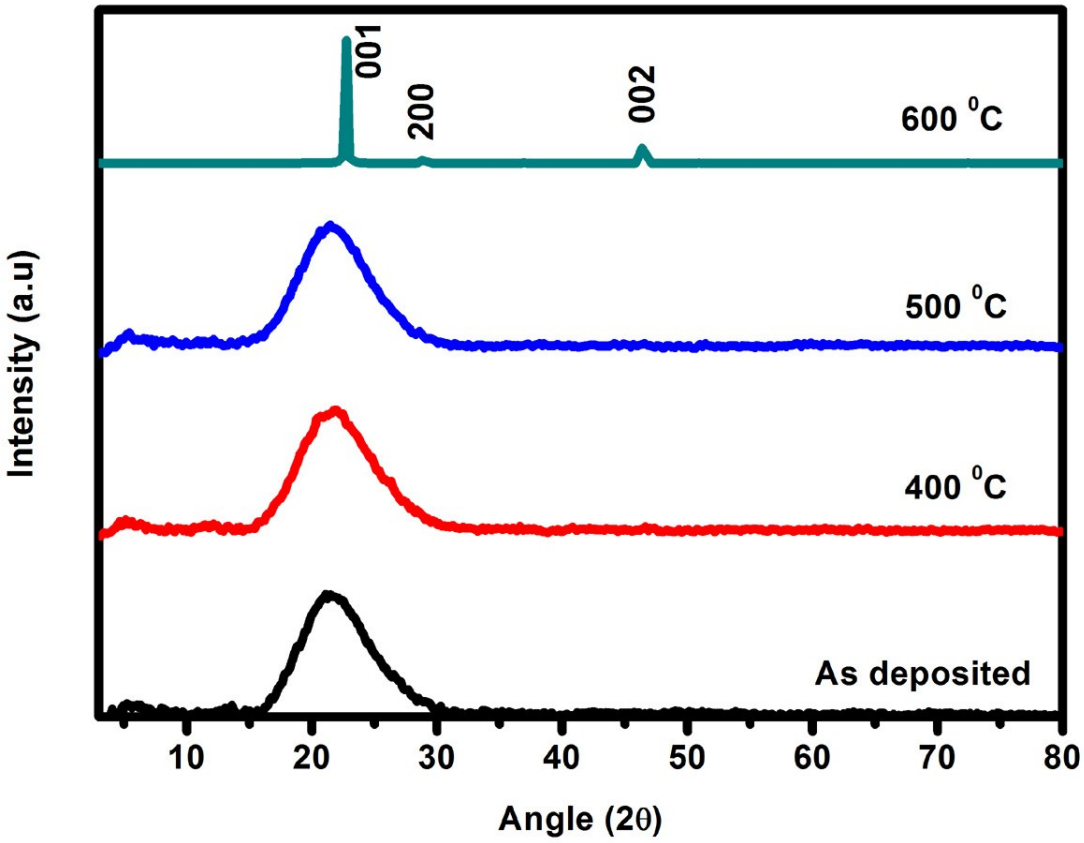
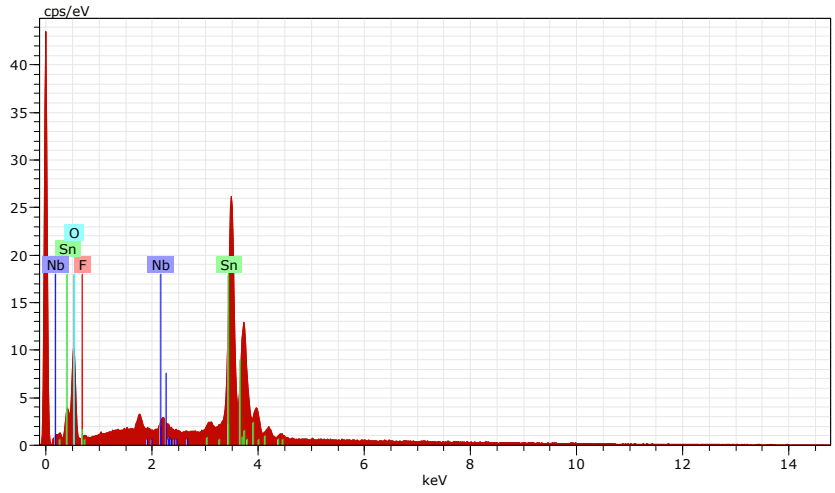


Figure S1. X-ray diffraction patterns of Nb_2O_5 thin film deposited on quartz substrate and annealed at 400 ^{0}C, 500 ^{0}C, 600 ^{0}C for 1 h. Absence of any distinct peaks in the as deposited and films annealed at a temperature of 400 ^{0}C, 500 ^{0}C respectively shows the amorphous nature and film annealed at a temperature of 600 ^{0}C shows peaks corresponding to 2θ values at 22.61 ^{0} , 28.41 ^{0} and 46.41^0 for the lattice reflection planes (001), (200), and (002) can be attributed to the orthorhombic phase (JCPDS card 30-0873) of Nb_2O_5.

Preparation of Iodide/Triiodide liquid electrolyte

15.9672g of 1-butyl-3 methyl imadasolium iodide, 1.3385g of lithium iodide, 6.7605g of 4-tert butyl 1 pyridine, 1.269g of iodine and 1.1816g of guanidium thyocyanate is dissolved in 100 ml acetonytrile and sonicated for 15 min.



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El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (1 Sigma) [wt.%]
F	9	K-series	0.05	0.09	0.18	0.08
Sn	50	L-series	42.76	67.78	22.82	1.32
Nb	41	L-series	1.00	1.58	0.68	0.07
O	8	K-series	19.28	30.56	76.32	2.67
		Total:	63.09	100.00	100.00	

Figure S2: Energy dispersive X-ray spectrum (EDX) and mapping measurements of BL 11. The peak position of Nb_2O_5 can be seen along with other elements

Spectroscopic Ellipsometric observation: Nb_2O_5 thin film deposited on a quartz substrate at a RF power of 150W for 30 minutes and one set is annealed at 600 ˚C. Classical model is used to fit the data and the films were considered as homogeneous thin film. The Ψ and Δ data were acquired at an angle of incidence 70º and the best fitted results are shown in the table

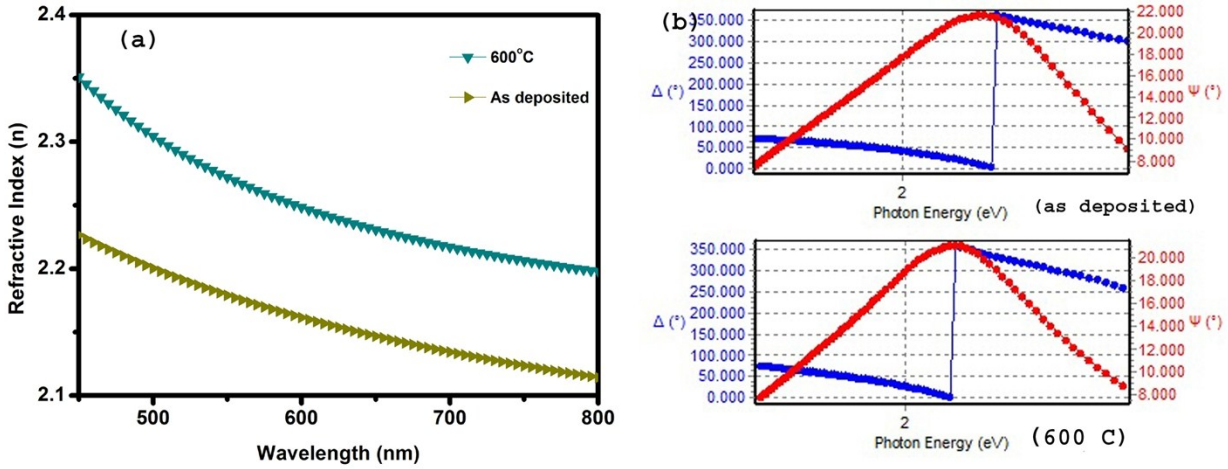

Figure S3: (a) shows the variation of refractive index (n) of the as deposited and annealed films as a function of wavelength. (b) is the experimental and fitted curves delta (Δ) and psi(Ψ) from spectroscopic ellipsometry measurements.

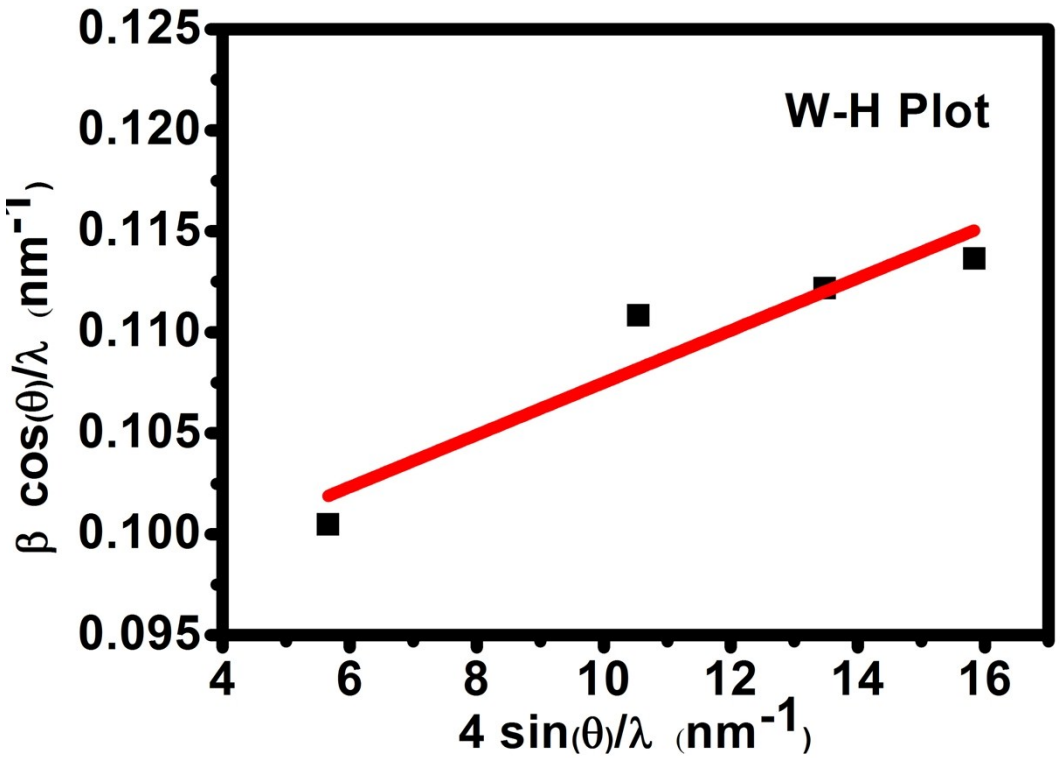

Figure S4: Williamsons – Hall plot of TiO_2 nano particle. Crystallite size (D) is calculated from the Williamson-Hall relation given as $\frac{\beta_{2\theta\cos\theta}}{\lambda} = \frac{K}{D} + \frac{4\varepsilon\sin\theta}{\lambda}$.

Table 1:

Film	χ^2	Thickness (nm)	n [632 nm]	ε_r
As deposited	0.011	141.5 ± 0.8	2.15	4.63
600 °C	0.048	139.8± 1.9	2.23	5.00

Table 2: Cell impedance parameters from I-V characteristics The thickness of the BL is approximated by taking a deposition rate of 1 nm/min. at 100 W RF power.

BL sputtering time	BL thickness (nm)	Series resistance Rs (Ω)		Shunt resistance Rsh (Ω)	
		amorphous	crystalline	amorphous	crystalline
10 min.	~10 nm	32.65	34.96	0.70	24451.71
20 min.	~20 nm	230.45	37.13	0.55	39412.25
30 min.	~30 nm	71.60	39.36	0.79	72459.10
40 min.	~40 nm	64.95	32.95	0.75	33527.83
60 min.	~60 nm	380.66	36.06	0.79	40690.10
80 min.	~80 nm	610.79	42.75	0.50	62804.03

Table 3: Electron response time calculated from OCVD analysis.

	Decay potential (Volts)	Sample code			
		40	40A	80	80A
Electron response time (τ_n) (sec) at different decay potentials	0.6	0.769	0.1785	0.451	0.106
	0.5	4.139	0.383	2.21	0.141
	0.4	9.85	0.649	6.35	0.333