Nanorod to Nanosphere Transformation of Vanadium doped ZnO as influenced by Fuels and their Performance in Dye Sensitized Solar Cells

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Supporting information:

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FT-IR studies of pure and vanadium loaded ZnO nanocrystals

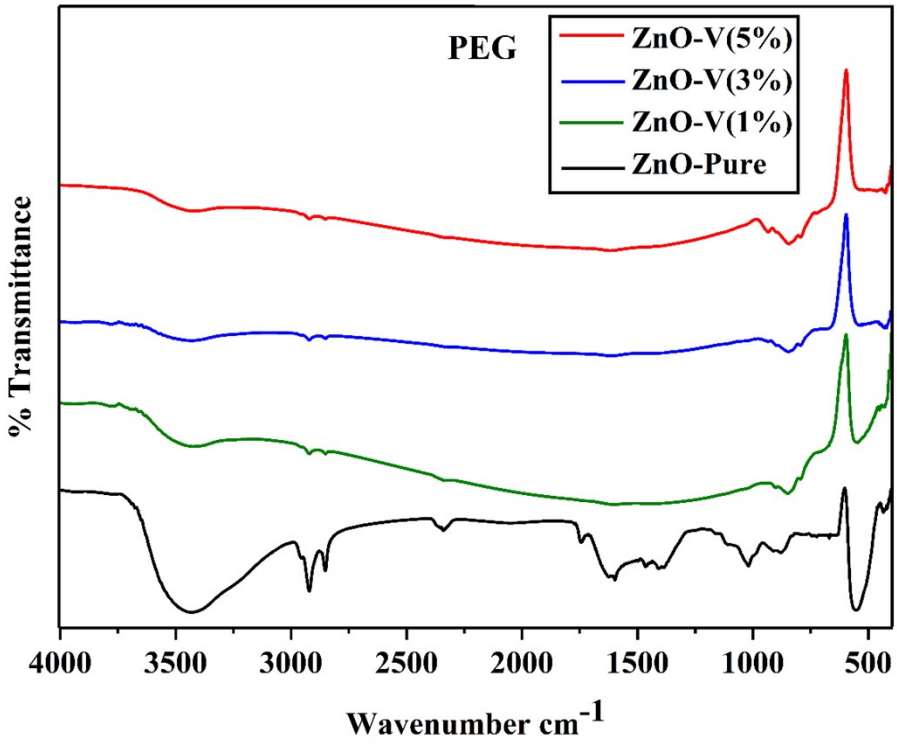

Figure S1. FTIR spectra of pure and vanadium loaded ZnO using PEG as fuel

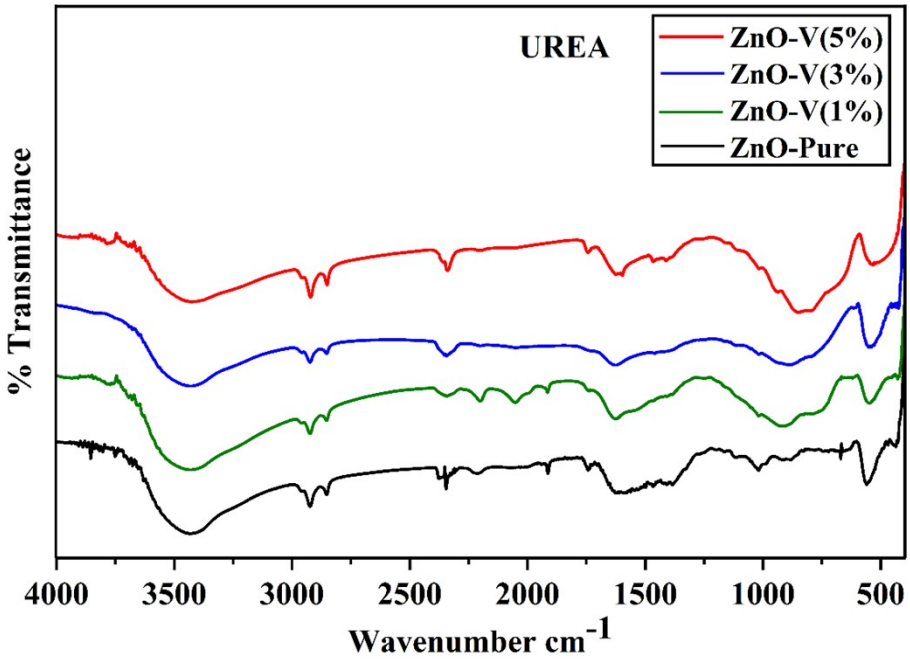

Figure S2. FTIR spectra of pure and vanadium loaded ZnO using urea as fuel

The FT-IR studies of the vanadium loaded and pure ZnO nanoparticles reveal the formation of Zinc and vanadium oxides and their corresponding stretching and bending vibration are observed and are given in Figure S1 and S2 for pure ZnO to ZnO-V (1%, 3%, and 5%) (PEG-400) and pure ZnO to ZnO-V (1%, 3%, and 5%) (Urea) respectively. From the FTIR study the peak at 554 cm^{-1} indicates the presence of ZnO nanocrystals. The peak at 1017 cm^{-1} indicates the presence of V=O stretching vibration frequency. There is a peak at 1396 cm^{-1} denotes CH_3 umbrella type bent of vibration. The peaks obtained in the range of 1400-1500 cm^{-1} correspond to C=O bonds. Then the peak obtained at 1585 cm^{-1} assigned O-H bending vibrations. The peak at 1395 cm^{-1} and 1469 cm^{-1} corresponds to C=O and O-H bending vibrations respectively. The peak at 2852 shows CH_3 symmetric stretching vibration. Finally, the broad peak at 3430 cm^{-1} indicates the O-H stretching vibration.

X-Ray diffraction

Table S1. d -spacing and lattice parameter for Pristine ZnO (PEG)

2Ɵ(degree)	Ɵ (degree)	sin Ɵ	d Å)	d-spacing (nm)	hkl	Lattice parameter (Å)
31.8	15.9	0.274	2.811	0.2811	100	
34.5	17.2	0.296	2.601	0.2601	002	5.1938 Å
36.3	18.1	0.312	2.469	0.2649	101	
47.6	23.8	0.404	1.905	0.1905	102	
56.7	28.3	0.474	1.624	0.1624	110	
62.9	31.4	0.522	1.476	0.1476	103	
66.5	33.2	0.548	1.406	0.4060	200	
68.0	34.0	0.559	1.378	0.1378	112	
69.2	34.6	0.567	1.359	0.1359	201	

Table S2. Crystallite size calculated from Debye–Scherrer equation

	Crystallite Size(nm)	
Samples	**PEG 400**	**Urea**
ZnO - Pure	61	49
ZnO-V1%	53	35
ZnO-V3%	56	43
ZnO-V5%	58	53

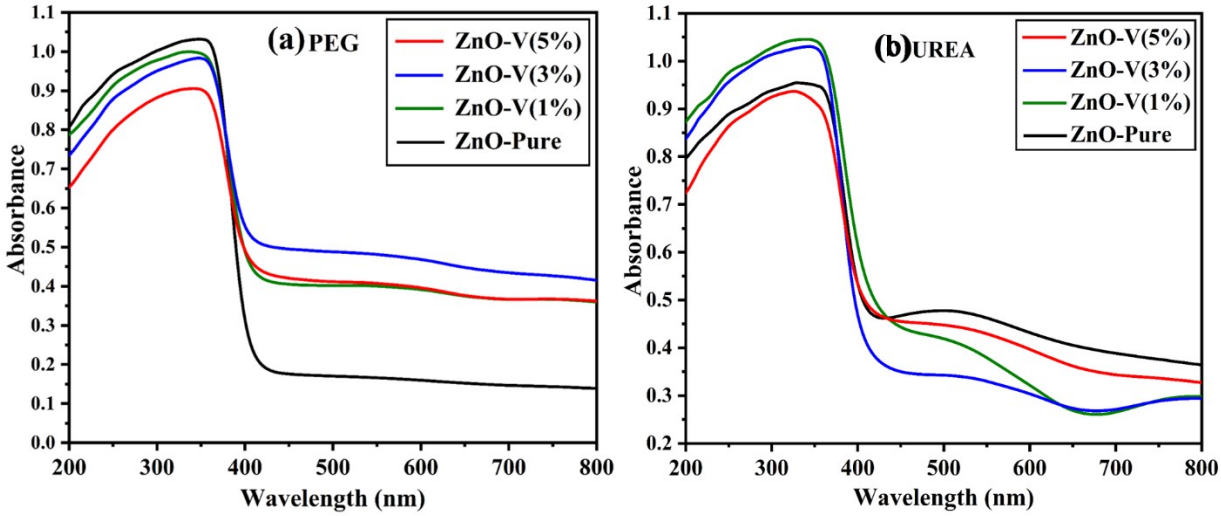

Figure S3. Absorbance spectra of (a) PEG and (b) Urea fuel samples.

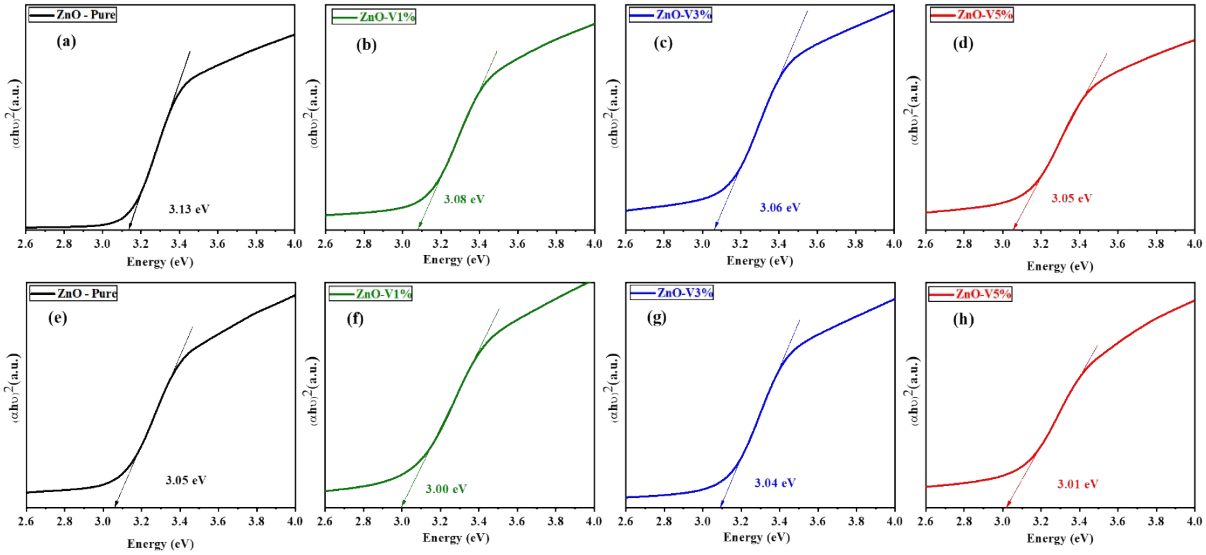

Figure S4. Tauc plot of PEG (a-d) and urea (e-h).

Table S3. Bandgap calculated from Tauc plot method

Bandgap (eV)		
Samples	**PEG 400**	**Urea**
ZnO - Pure	3.13	3.03
ZnO-V1%	3.08	3.00
ZnO-V3%	3.06	3.04
ZnO-V5%	3.05	3.01

Table S4. Fabricated DSSC device parameters from EIS analysis.

DSSC Device	$R_s(\Omega)$	$R_{ct}(\Omega)$	$R_{rec}(\Omega)$	$Z_w(\Omega)$	f_{max}(Hz)	η(%)
ZnO-V5% (PEG)	7.70	0.71	3.12	11.53	0. 251	5.4
ZnO-V5% (Urea)	7.60	0.64	1.84	10.08	0. 316	4.9
ZnO- Pure (PEG)	8.75	0.72	1.63	11.10	0.362	4.1
ZnO- Pure (Urea)	9.00	0.52	1.34	10.86	0.400	3.1