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nanoGe HOPV15 — 10-13 May 2015 - Rome - Italy — Hybrid and Organic Photovoltaics Conference

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Issued on 13th May

This is to certify that **Mr. Abdullah Alsulami** has attended the **International Conference on Hybrid and Organic Photovoltaics 2015**, held from 10th to 13th May 2015, in Rome, Italy.

Mr. Abdullah Alsulami has presented a Poster contribution entitled **"Lifetime analysis and degradation study of OPVs utilising a solution processed V2O5 Intelayer".**

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Lifetime analysis and degradation study of OPVs utilising a solution processed V2O5 Intelayer

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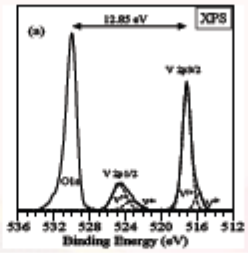
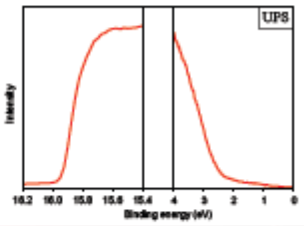
Summary

In recent years, several studies have shown that fabrication OPVs with s-V_2O_x exhibit high performance which are similar or better than other devices that utilise different HTLs. However, most of aqueous metal oxides reported in literature require post-deposition treatment such as thermal annealing and plasma treatment. Herein we fabricated V_2O_x thin films (5 nm thickness) by a spin-coating solutions of vanadium oxitriisopropoxide precursor at room temperature in air without any post-treatment. OPVs incorporating untreated s-V_2O_x thin film and active layer of PFD2TBT8:PC70BM shows efficiency up to 6.5 %. This is comparable to devices made with a thermally evaporated MoOx or PEDOT:PSS HTL.

However, preliminary lifetime results of s-V_2O_x devices have the shortest lifetime. Increasing V_2O_x layer thickness up to 20 nm with annealing at 110 ℃ for 20 minutes can improve significantly the lifetime to be comparable with other devices.

Photoelectron spectroscopy





The left figure shows the XPS spectra of the 6-nm s-V_2O_5 thin layer film that was prepared in air. As suggested by Coulston et al., [3, 4] the effective oxidation (or average oxidation) state can be estimated from the following linear relationship:

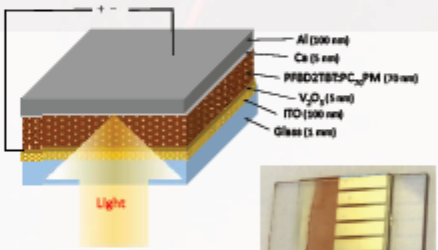
$$V_{ox} = 13.82 - 0.68\,[E_b(O1s) - E_b(V2P_{3/2})]$$

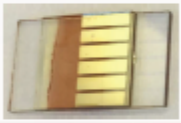
It was found that V_{ox} = 4.93.

The right figure shows the position of the secondary electron cut-off of the UPS spectrum exhibiting a work function of 5.2 eV.

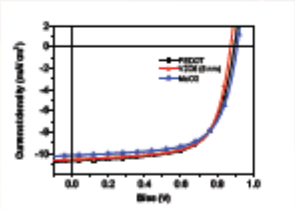
Fabrication process

- The substrates were cleaned in 3 steps with a water–Hellmanex solution, NaOH solution (10 wt%), and iso-propanol (99.99%).
- Vanadium oxitriisopropoxide was dissolved in iso-propanol at a concentration of 5 mg/mL. Thin films (5 nm) of vanadium oxide were deposited via spin coating onto ITO coated glass substrates.
- The active layer was prepared by mixing solutions of PFD2TBT8 and $PC_{70}BM$ at a weight ratio of 1:4 in chloroform with an overall concentration of 20 mg/mL.
- The PFD2TBT8:$PC_{70}BM$ solution then was spin coated at 3000 rpm in a glove box.
- A calcium (5 nm) then aluminium (100 nm) double layer cathode was deposited via thermal evaporation.
- Devices were encapsulated using an inert UV curable epoxy and a glass cover slide.
- OPV devices were measured under ambient conditions using a Keithley 2400 source meter and a Newport 92251A-1000 AM1.5 solar simulator.



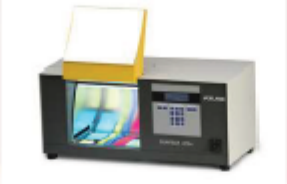


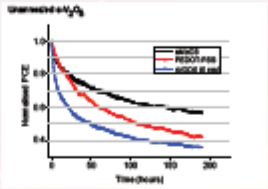
J-V characetristic

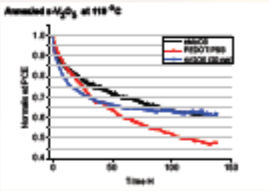


HEL	Maximum PCE (%)	Average PCE_{avg} (%)	Voc (V)	J_{sc} (mA/cm²)	FF (%)
s-V_2O_x	6.5	6.3 ± 0.15	0.87	10.6 ± 0.1	67.6 ± 1.2
PEDOT	6.6	6.3 ± 0.2	0.90	10.7 ± 0.4	65.3 ± 1.1
MoO_3	6.3	6.1 ± 0.11	0.91	10.1 ± 0.1	66.1 ± 1.2

Lifetime measurement







- Lifetime testing was carried out in an ATLAS Suntest CPS+ solar simulator with a 1500W xenon lamp.
- A quartz filter was used to reduce the IR portion of the emitted light.
- The temperature inside the testing chamber was held at (4062) C.

HTL		Average PCE (%)	Voc (V)	J_{sc} (mA/cm²)	FF (%)
PEDOT	Fresh	6 ± 0.18	0.89	10.7 ± 0.15	62.5 ± 1.2
	Aged	2.3 ± 0.10	0.83	8.8 ± 0.14	32.3 ± 0.6
VoOi	Fresh	5.4 ± 0.19	0.83	9.3 ± 0.42	66.2 ± 1.3
	Aged	2.9 ± 0.04	0.80	8.3 ± 0.17	43.7 ± 0.6
MoOi	Fresh	5.4 ± 0.13	0.80	8.7 ± 0.22	68.2 ± 0.5
	Aged	3.8 ± 0.23	0.80	7.2 ± 0.32	49.2 ± 0.2

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