明志科技大學材料工程系105學年四技專題製作競賽

題　　目：**Interfacial modification layers based on carbon dots for efficient inverted polymer solar cells**

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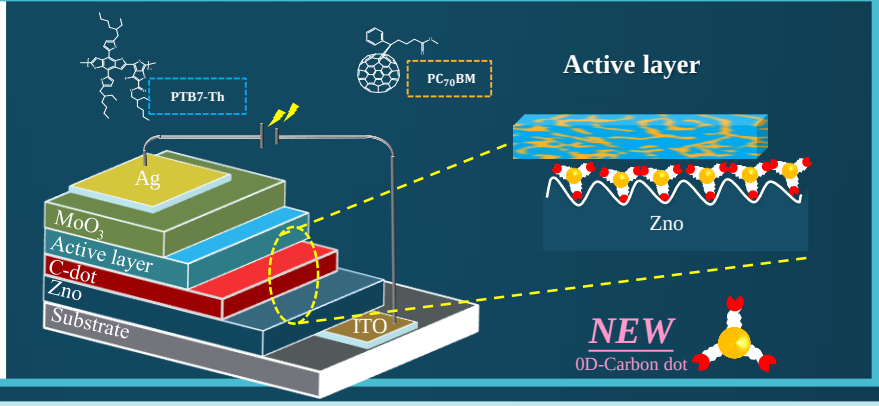
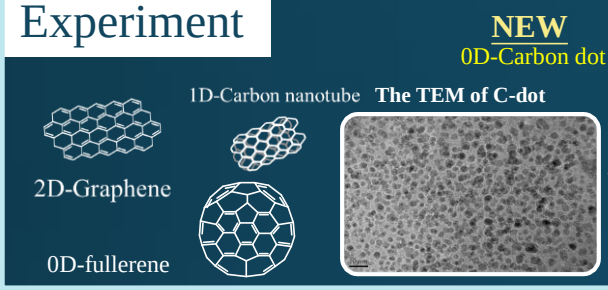
Abstract

In this study, we found that interfacial layers (IFLs) based on carbon dots(C-dots) with carboxylic groups, for the first time, were used as an efficient interfacial modification layer on the ZnO interlayers, greatly improving the device performance. The C-dots modifying showed decreased work function and smoothed surface of metal oxides, facilitating the enhancement of charge extraction efficiency and the decrease of recombination losses for the cathode. As a result, by incorporating ZnO/C-dots as the interlayers, Notably, a maximum PCE of up to 9.55 % was achieved with the Zno/C-dots as the interlayers and PTB7-Th:$PC_{70}BM$ as the active layer .

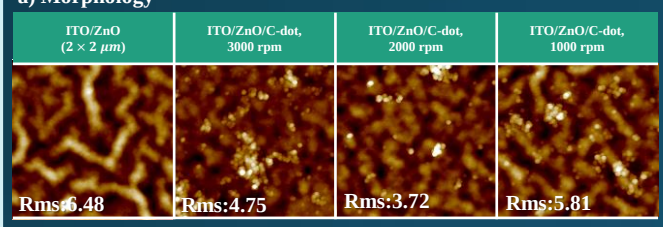


Experiment



Results & Discussion

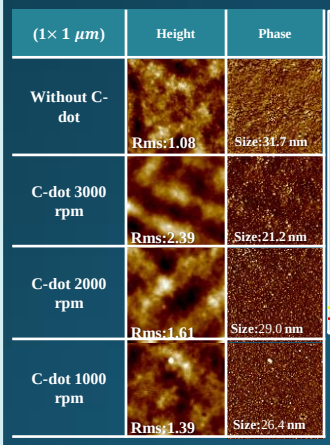
a) Morphology



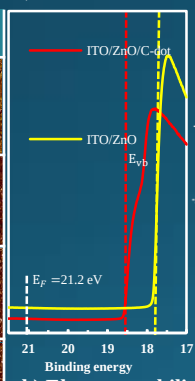
b) Surface energy

Contact angle	Θ water [°]	Θ DIM [°]	γ_{polar} [mN m^{-1}]	$\gamma_{dispersive}$ [mN m^{-1}]	γ_{total} [mN m^{-1}]
ITO/ZnO	38.05	37.17	27.8	41.43	69.29
ITO/ ZnO / C-dot	13.04	31.69	36.81	43.75	80.57

c) Phase(ITO/ZnO/C-dot/Active layer)



f) UPS

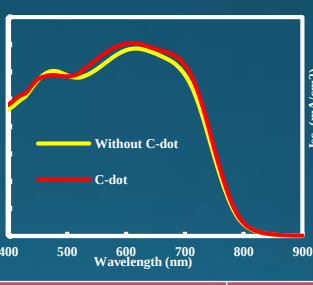


g) Energy level

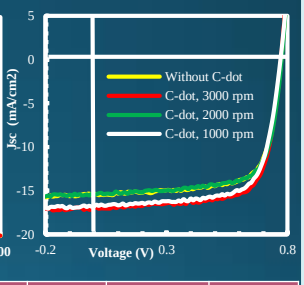
h) Electron mobility

	(m^{-1}V^{-1}s^{-1})
Without	1.75×10^{-8}
With C-dot	4.82×10^{-8}

i) IPCE



j) J-V curve



Devices	J_{sc}(mA/cm^2)	V_{oc}(V)	F.F(%)	PCE(%)
Without C-dot	15.39	0.77	72.7	8.62
C-dot, 3000 rpm	17.02	0.77	72.8	9.55
C-dot, 2000 rpm	15.85	0.76	72.5	8.84
C-dot, 1000 rpm	16.64	0.77	70.7	9.05

Conclusion

- Interfacial modification layers can let active layers surface morphology degrees of phase segregation.
- Interface dipole created by C-dots with Carboxylic acid on the surface it can made a vacuum level shift of about 0.8 eV.
- Interfacial modification layers based on carbon dots for efficiency improve PCE from 8.6% to 9.5%.