Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary Information for

Curing Temperature Reduction and Performance Improvement of Solution-Processable Hole-Transporting Materials for Phosphorescent OLEDs by Manipulation of Cross-Linking Functionalities and Core Structures

Shahid Ameen,[‡abc] *Jaemin Lee,*[‡ab] *Hyun Han,*[a] *Min Chul Suh,*[*d] *and Changjin Lee*[*ab]

[a] Advanced Materials Division, Korea Research Institute of Chemical Technology, Daejeon 305-600, Republic of Korea

[b] University of Science & Technology (UST), Daejeon 305-333, Republic of Korea

[c] Department of Chemistry, Kohat University of Science and Technology (KUST), Kohat 26000, Pakistan

[d] Department of Information Display, Kyung Hee University, Dongdaemun-gu, Seoul, 130-701, Republic of Korea

[‡] These authors contributed equally.

[*] Corresponding author : Prof. Min Chul Suh (E-mail : mcsuh@khu.ac.kr)

[*] Corresponding author : Dr. Changjin Lee (E-mail : cjlee@krict.re.kr)

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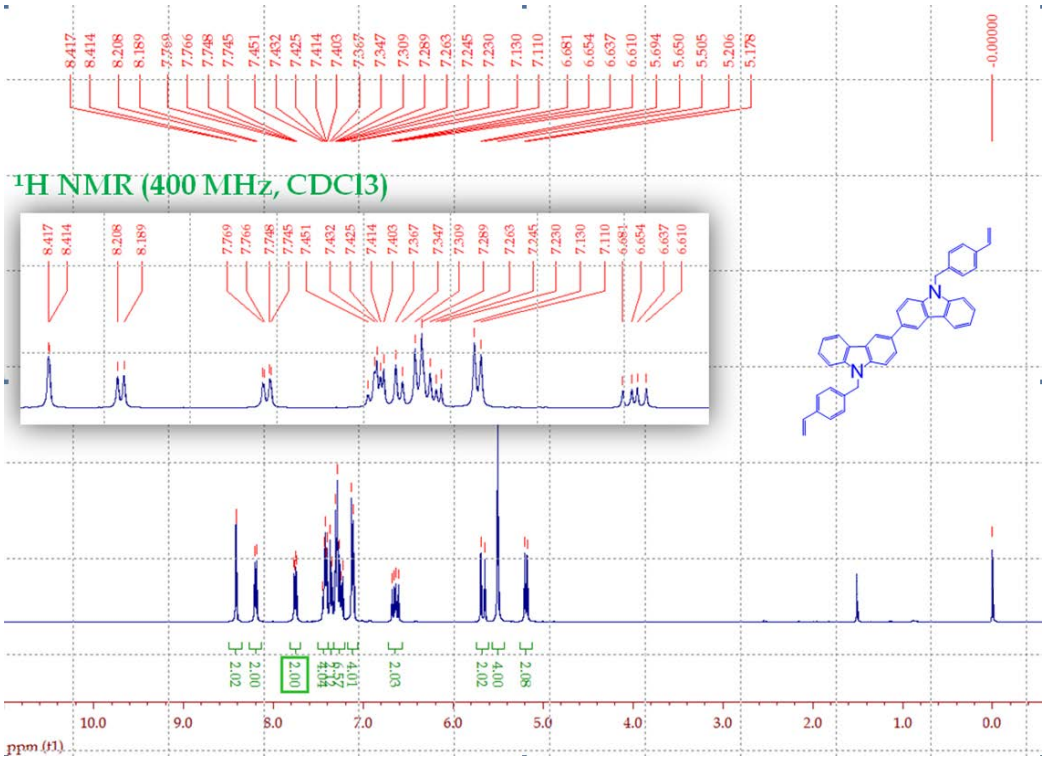
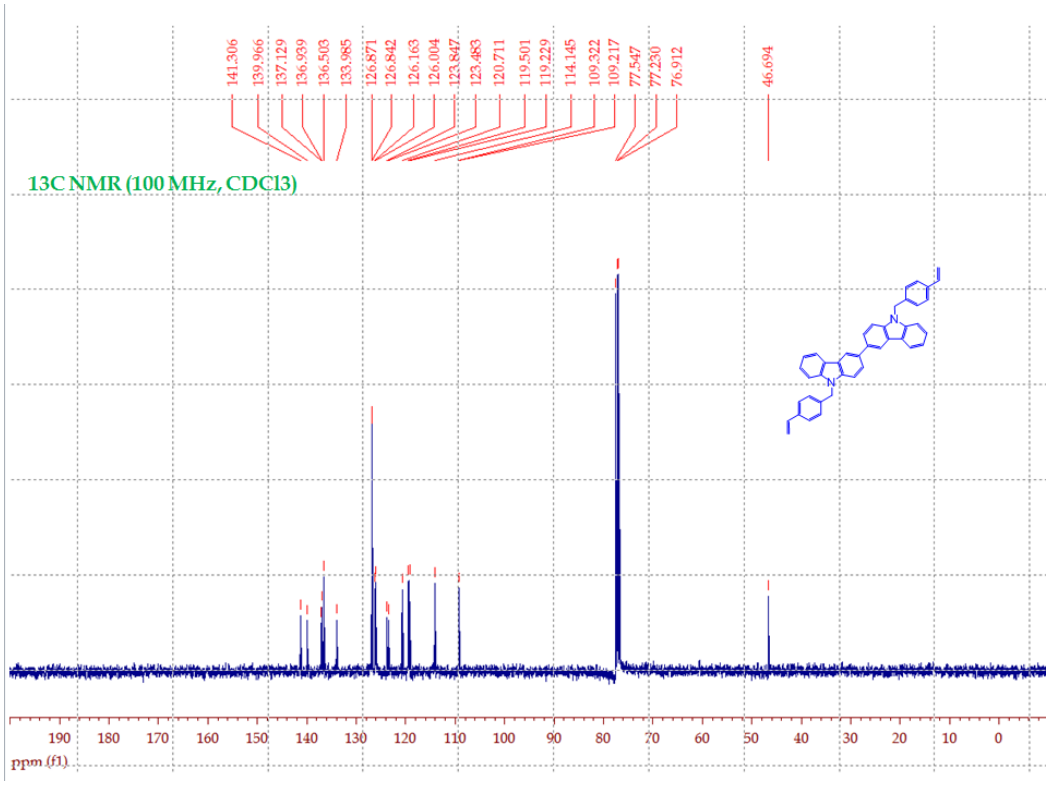
Fig. S1 (a) ^{1}H NMR, (b) ^{13}C NMR and (c) FAB-MS spectra of **BCzMS**.

(a)



(b)



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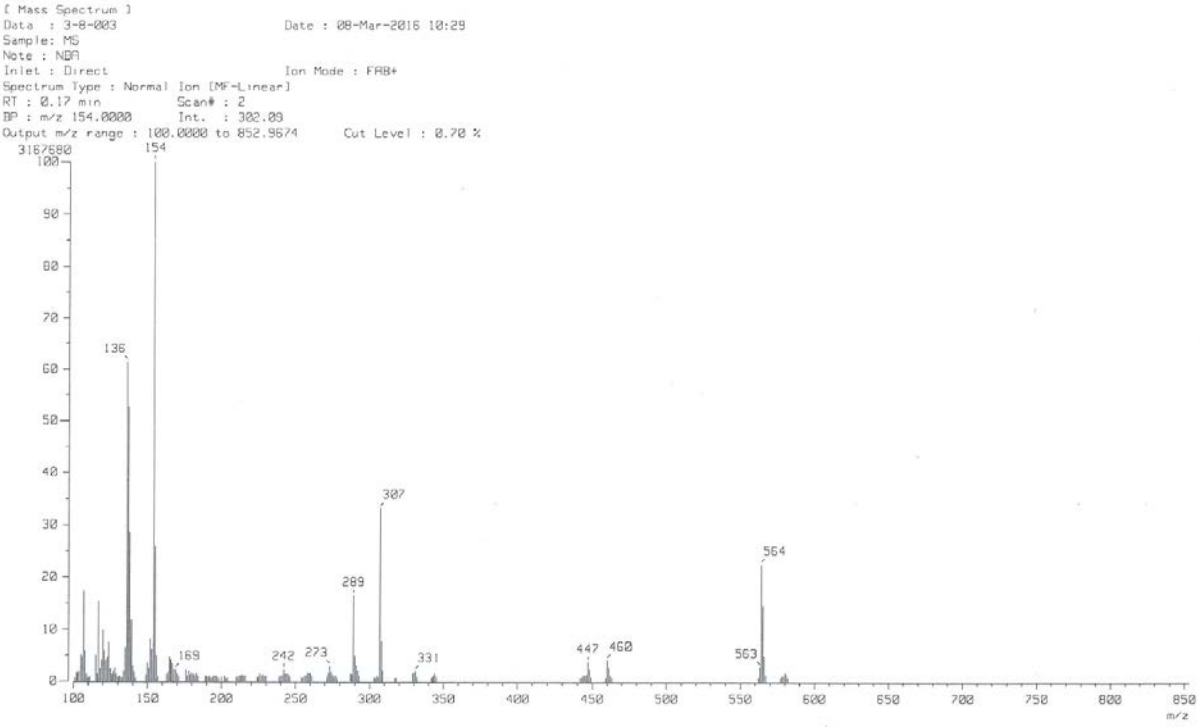
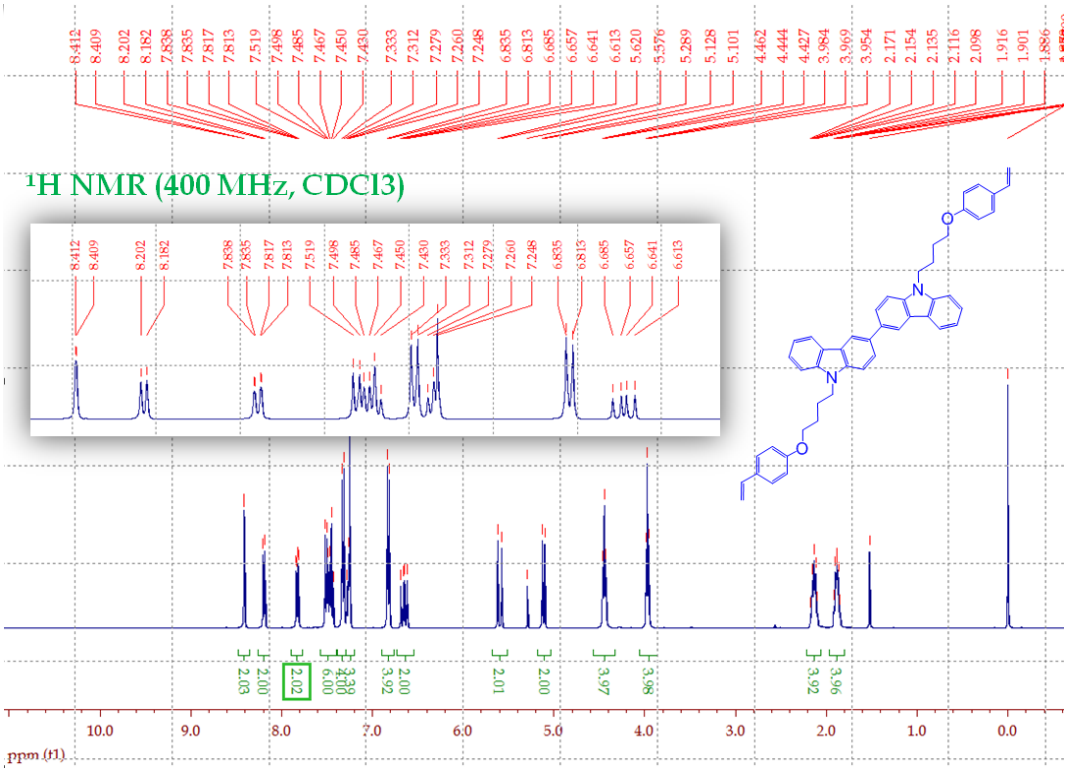
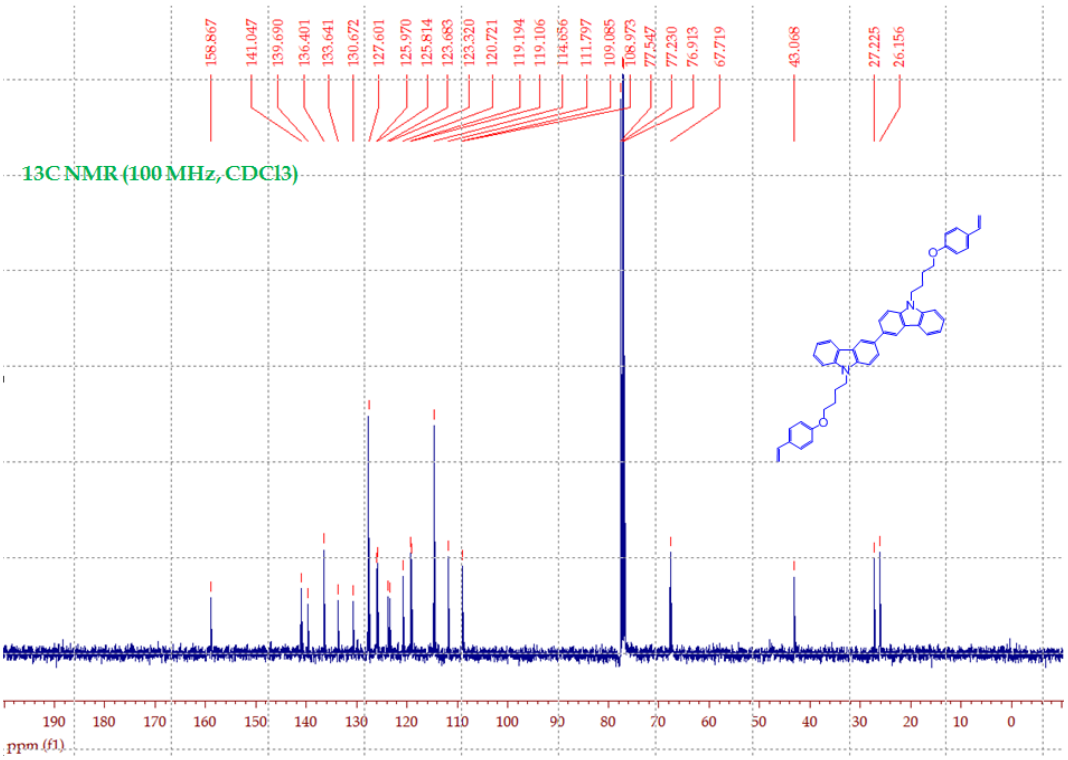

[Mass Spectrum]
Data : 3-8-003
Date : 08-Mar-2016 10:29
Sample: MS
Note : NBA
Inlet : Direct
Ion Mode : FAB+
Spectrum Type : Normal Ion [MF-Linear]
RT : 0.17 min
Scan# : 2
BP : m/z 154.0000
Int. : 302.00
Output m/z range : 100.0000 to 852.9674
Cut Level : 0.70 %
3167680
154
136
307
289
564
169
242
273
331
447
460
563
m/z

Fig. S2 (a) ^{1}H NMR, (b) ^{13}C NMR and (c) FAB-MS spectra of **BCzBOS**.

(a)



(b)



(c)

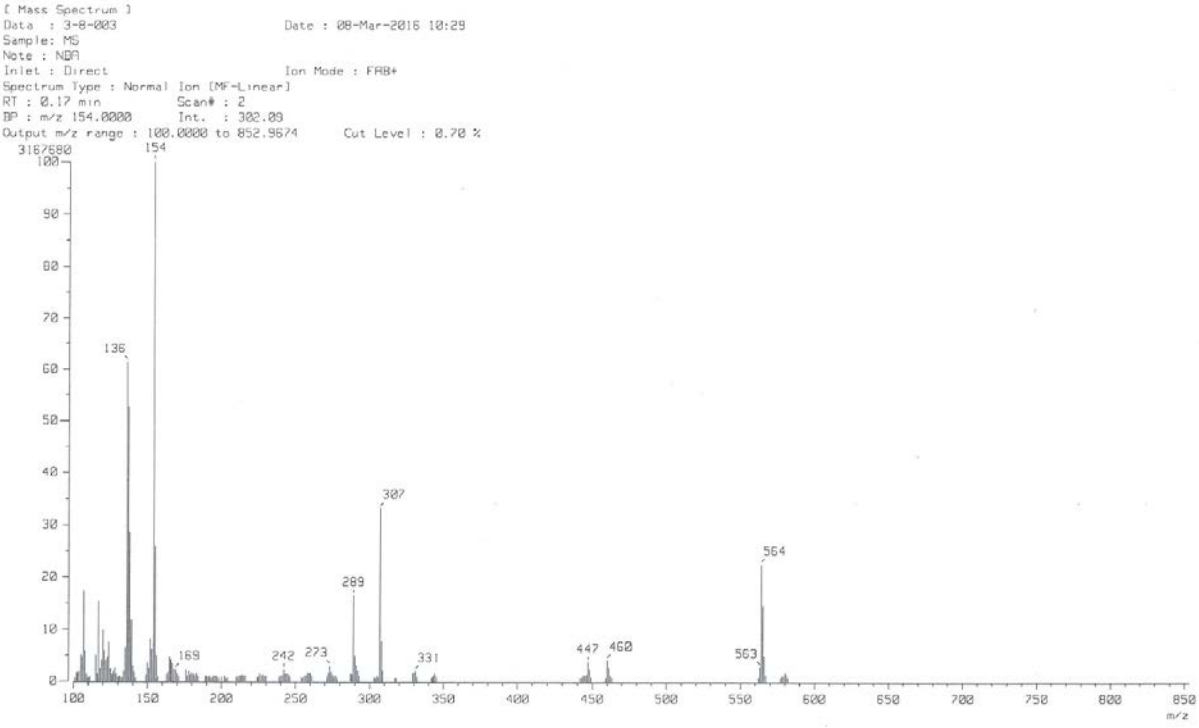
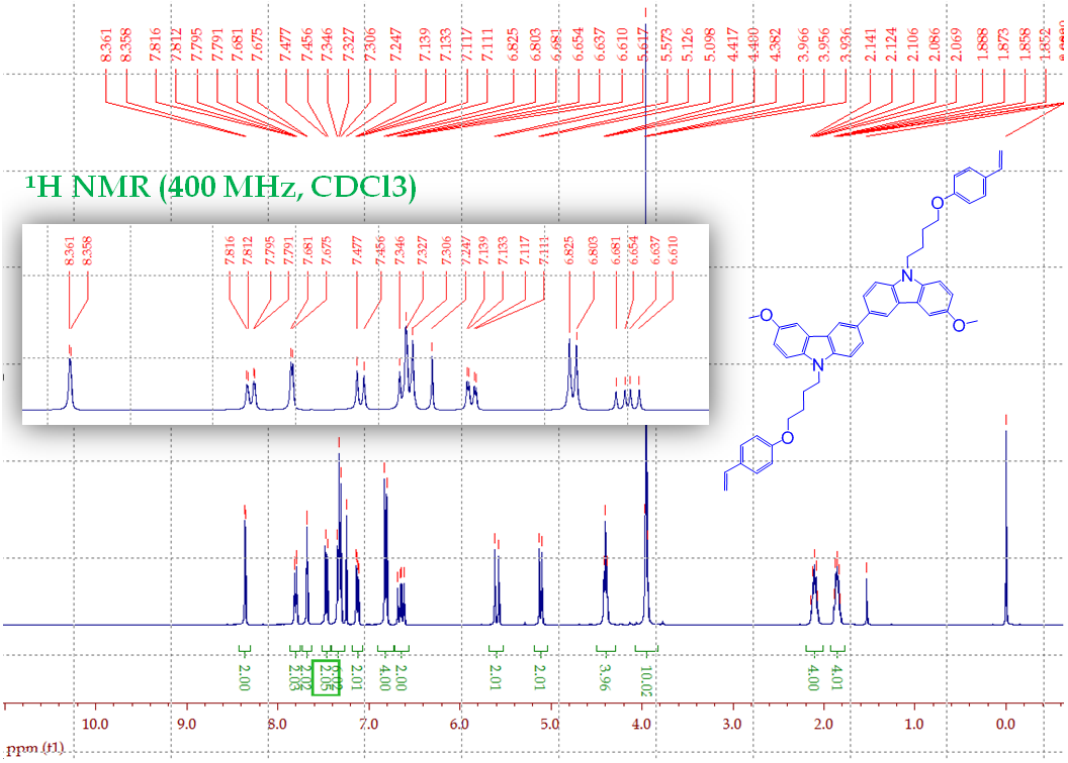

[Mass Spectrum]
Data : 3-8-003
Date : 08-Mar-2016 10:29
Sample: MS
Note : NBA
Inlet : Direct
Ion Mode : FAB+
Spectrum Type : Normal Ion [MF-Linear]
RT : 0.17 min
Scan# : 2
BP : m/z 154.0000
Int. : 302.00
Output m/z range : 100.0000 to 852.9674
Cut Level : 0.70 %
316/680
154
136
307
289
564
169
242
273
331
447
460
563
m/z

Fig. S3 (a) ^{1}H NMR, (b) ^{13}C NMR and (c) FAB-MS spectra of **MeO-BCzBOS**.

(a)



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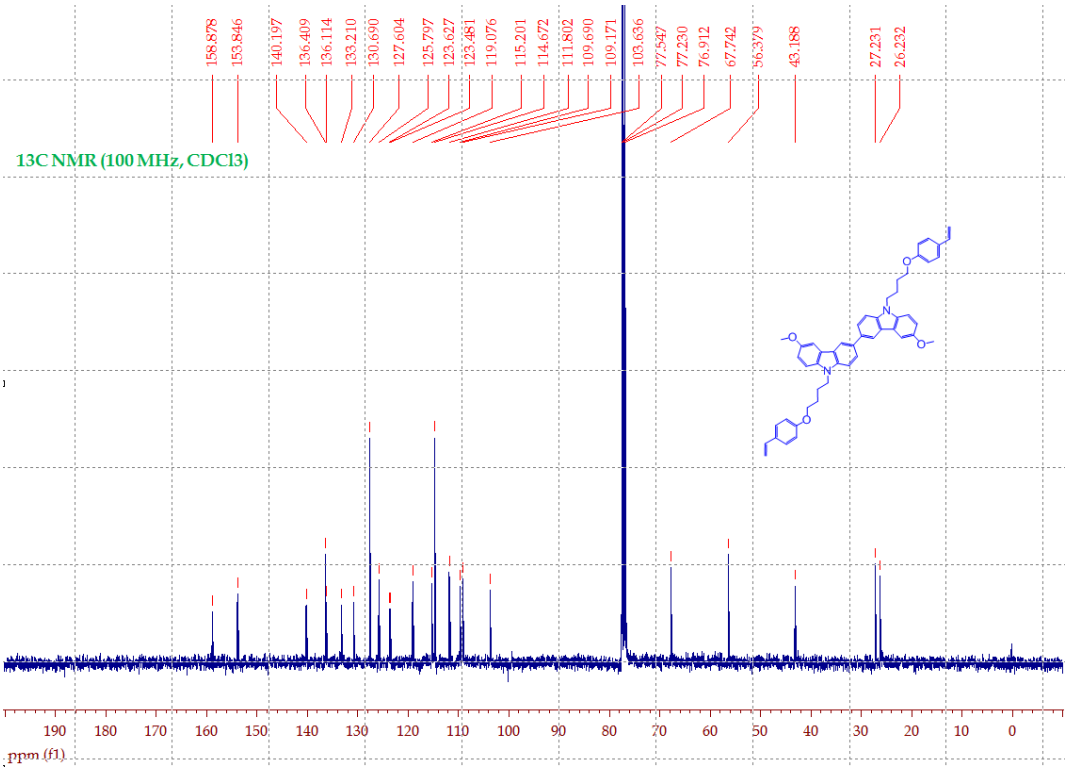

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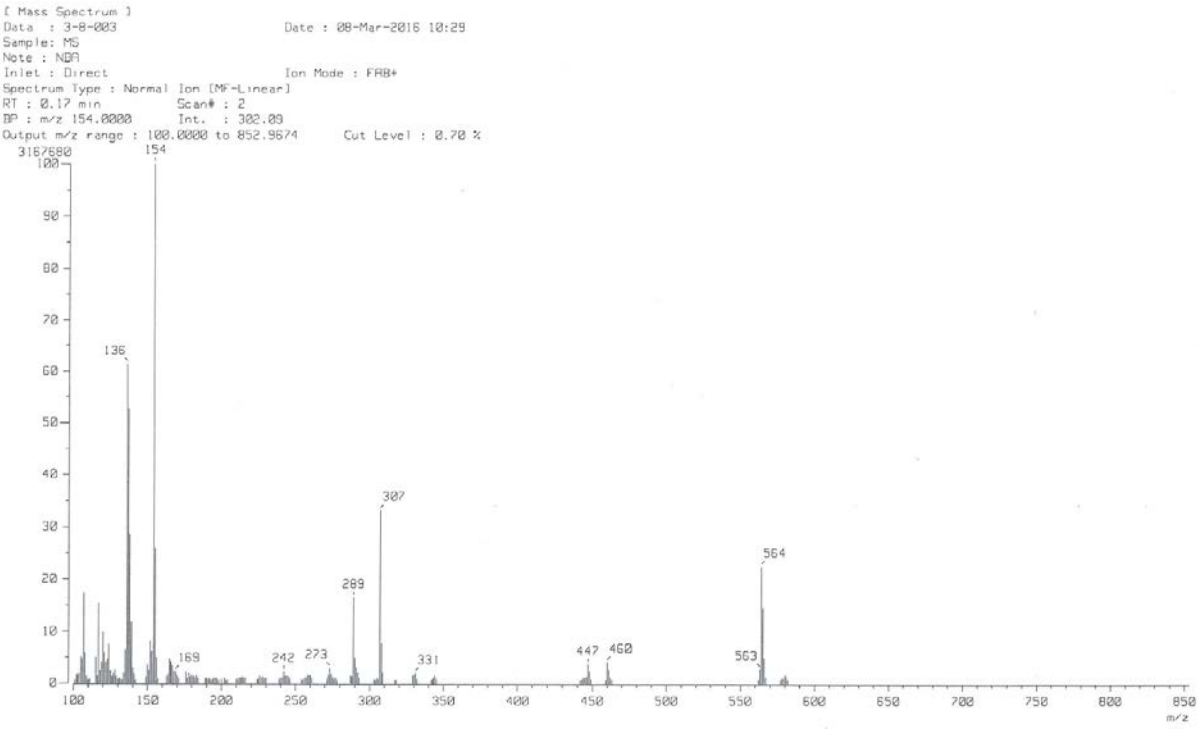
[Mass Spectrum]
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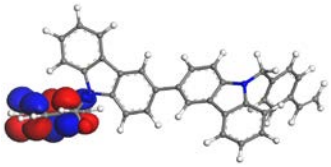
Date : 08-Mar-2016 10:29
Sample: MS
Note : NBA
Inlet : Direct
Ion Mode : FAB+
Spectrum Type : Normal Ion [MF-Linear]
RT : 0.17 min
Scan# : 2
BP : m/z 154.0000
Int. : 302.00
Output m/z range : 100.0000 to 852.9674
Cut Level : 0.70 %
3167680
154
136
307
289
564
169
242
273
331
447
460
563
m/z

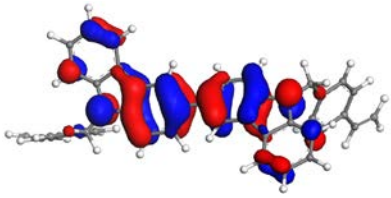
Fig. S4 Molecular surfaces of (a) **BCzMS**, (b) **BCzBOS** and (c) **MeO-BCzBOS** by DFT calculation.

(a)

LUMO
(-1.25 eV)

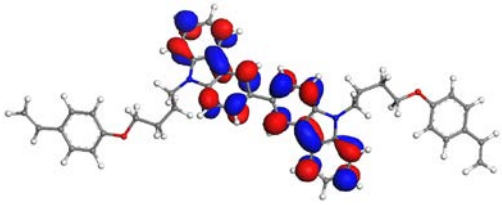


HOMO
(-5.19 eV)

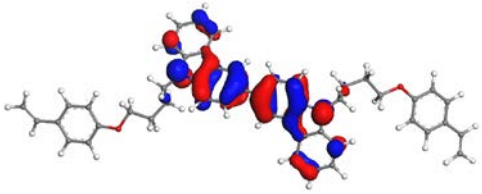


(b)

LUMO
(-0.99 eV)

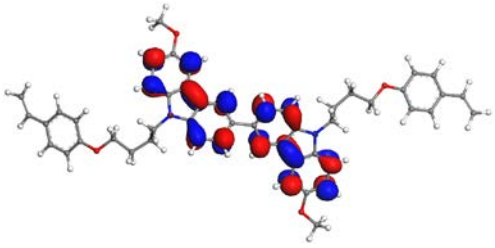


HOMO
(-5.28 eV)



(c)

LUMO
(-1.03 eV)



HOMO
(-4.96 eV)

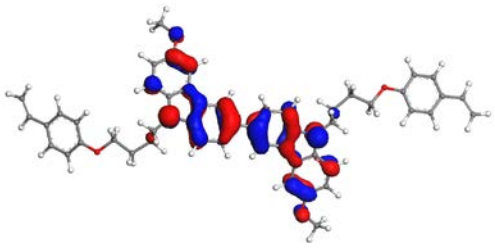


Fig. S5 Second heating scans of the cross-linkable HTL materials **BCzMS**, **BCzBOS** and **MeO-BCzBOS**

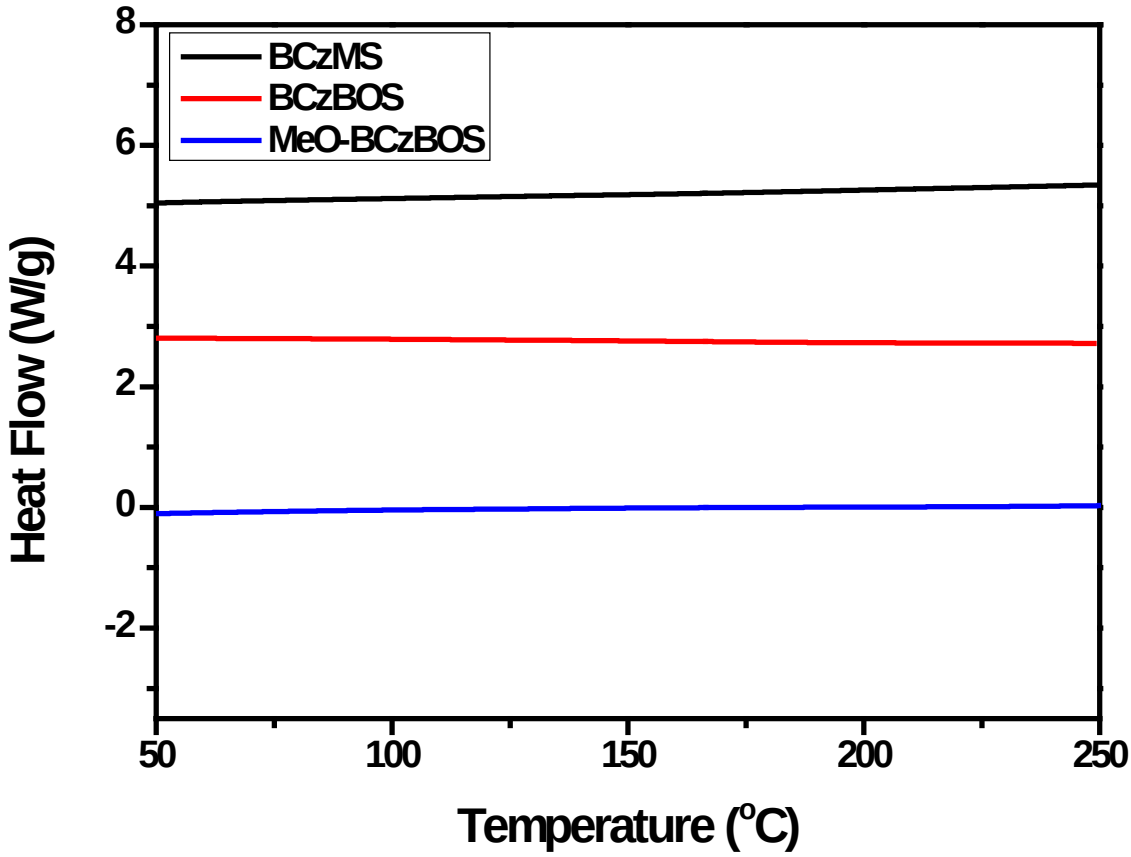
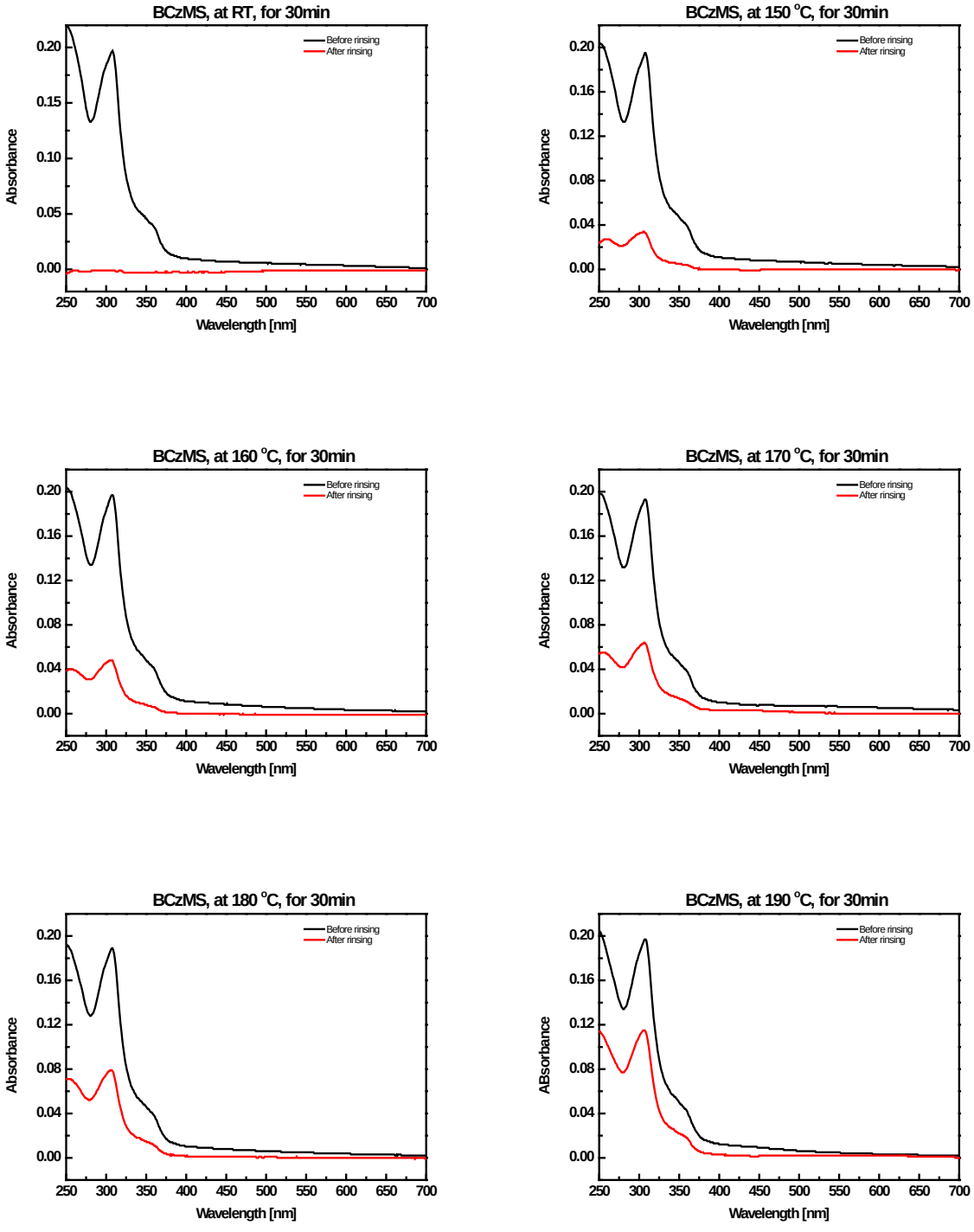
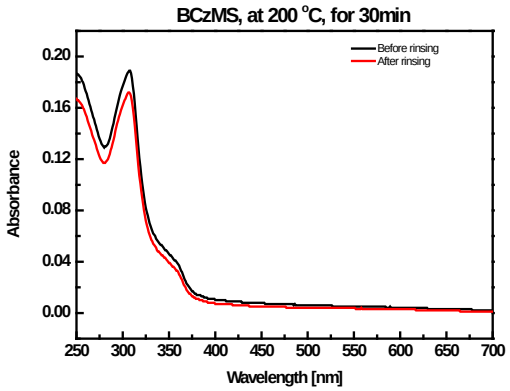


Fig. S6 UV-Vis. absorption spectra of thermally cross-linked **BCzMS** films before and after solvent rinsing with different thermal curing temperatures.




BCzMS, at 200 °C, for 30min
Before rinsing
After rinsing
Absorbance
0.20
0.16
0.12
0.08
0.04
0.00
250
300
350
400
450
500
550
600
650
700
Wavelength [nm]

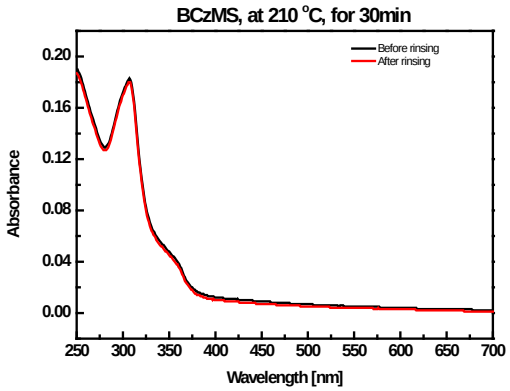
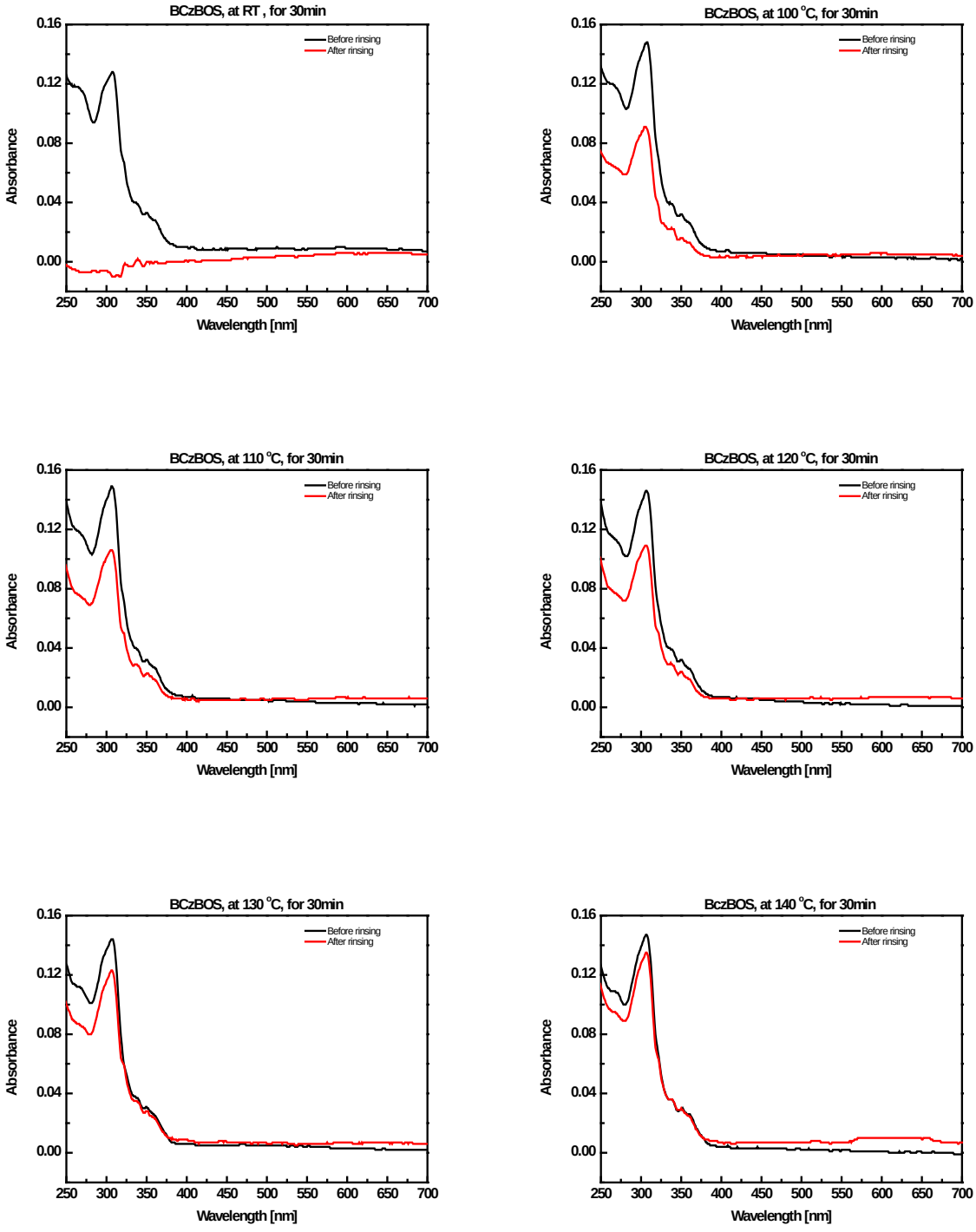
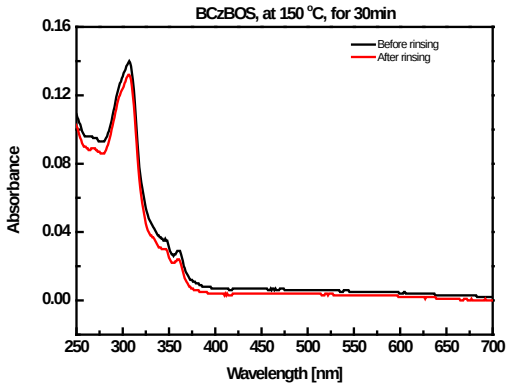
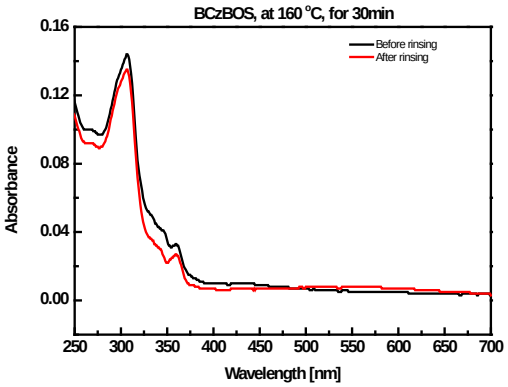
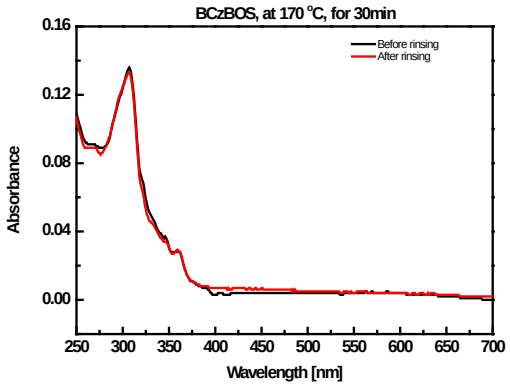

BCzMS, at 210 °C, for 30min
Before rinsing
After rinsing
Absorbance
0.20
0.16
0.12
0.08
0.04
0.00
250
300
350
400
450
500
550
600
650
700
Wavelength [nm]

Fig. S7 UV-Vis. absorption spectra of thermally cross-linked **BCzBOS** films before and after solvent rinsing with different thermal curing temperatures.




BCzBOS, at 150 °C, for 30min
Before rinsing
After rinsing
Absorbance
Wavelength [nm]


BCzBOS, at 160 °C, for 30min
Before rinsing
After rinsing
Absorbance
Wavelength [nm]


BCzBOS, at 170 °C, for 30min
Before rinsing
After rinsing
Absorbance
Wavelength [nm]

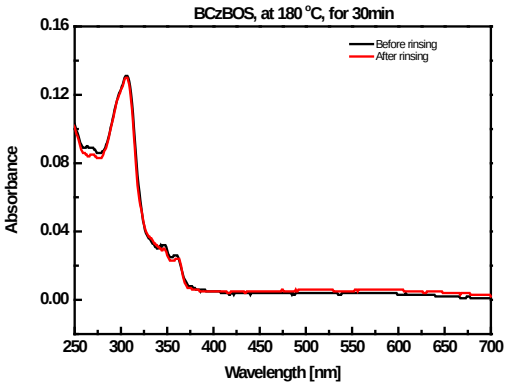
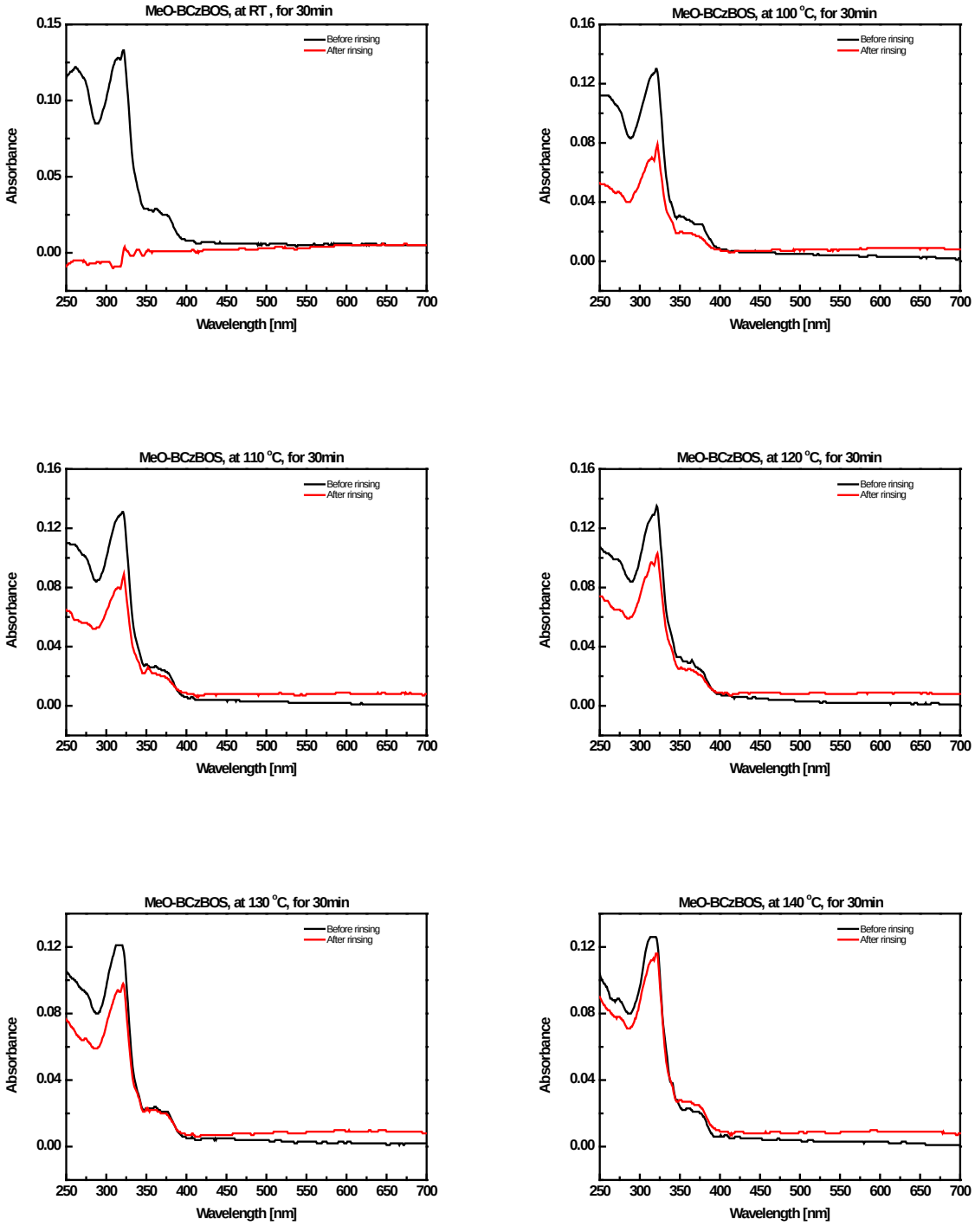
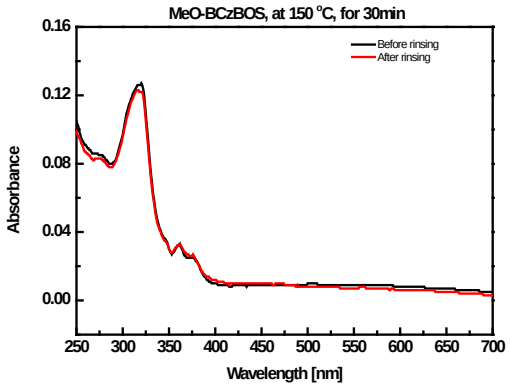
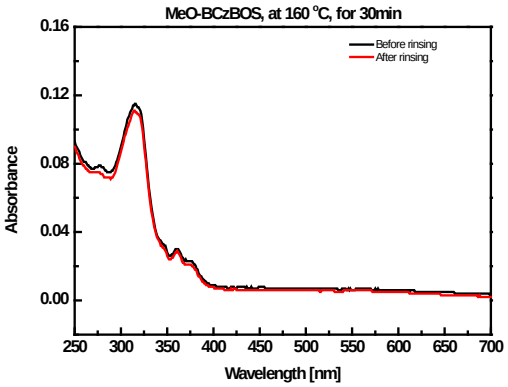
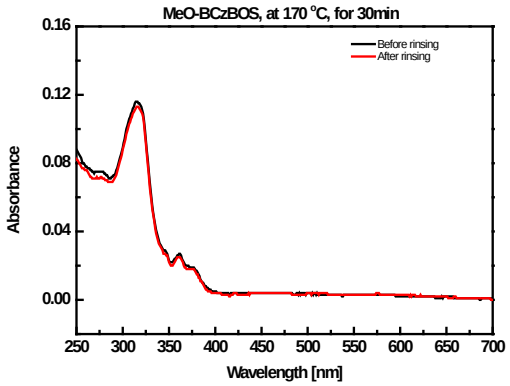

BCzBOS, at 180 °C, for 30min
Before rinsing
After rinsing
Absorbance
Wavelength [nm]

Fig. S8 UV-Vis. absorption spectra of thermally cross-linked **MeO-BCzBOS** films before and after solvent rinsing with different thermal curing temperatures.




MeO-BCzBOS, at 150 °C, for 30min
Before rinsing
After rinsing
Absorbance
Wavelength [nm]


MeO-BCzBOS, at 160 °C, for 30min
Before rinsing
After rinsing
Absorbance
Wavelength [nm]


MeO-BCzBOS, at 170 °C, for 30min
Before rinsing
After rinsing
Absorbance
Wavelength [nm]

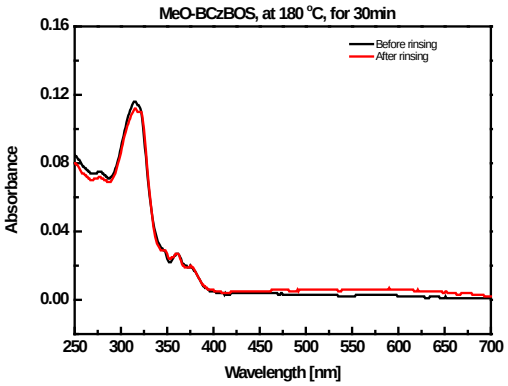

MeO-BCzBOS, at 180 °C, for 30min
Before rinsing
After rinsing
Absorbance
Wavelength [nm]

Fig. S9 Electroluminescence spectra of the HTL-containing OLED devices.

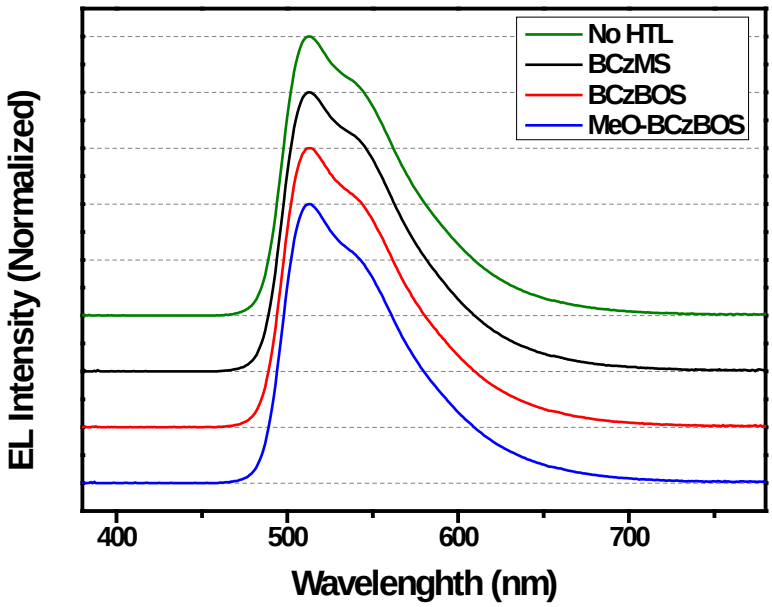
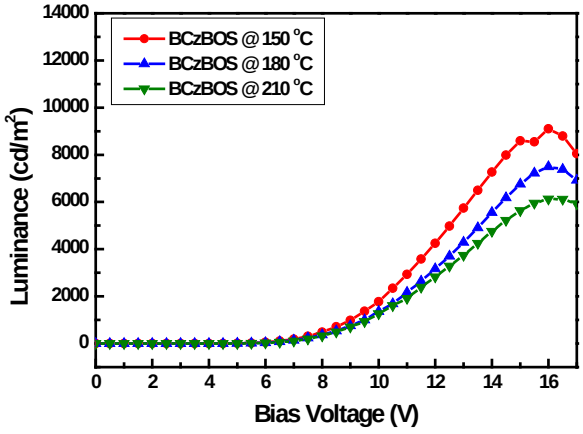


Fig. S10 Luminance-Voltage characteristics of OLEDs by changing the thermal curing temperatures of (a) **BCzBOS** and (b) **BCzMS**.

(a)



(b)

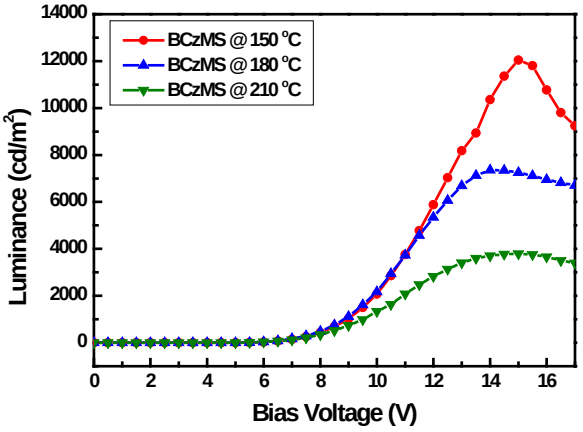
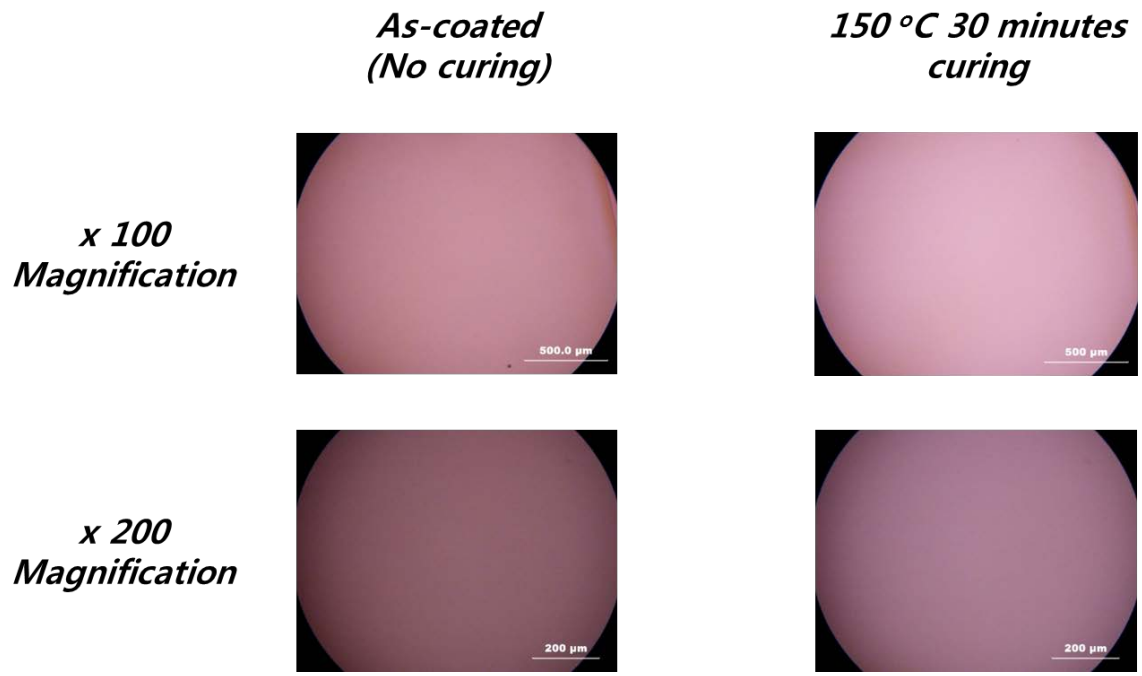


Fig. S11 Optical microscope images of the (a) **BCzBOS** and (b) **MeO-BCzBOS** HTL films.

(a)



(b)

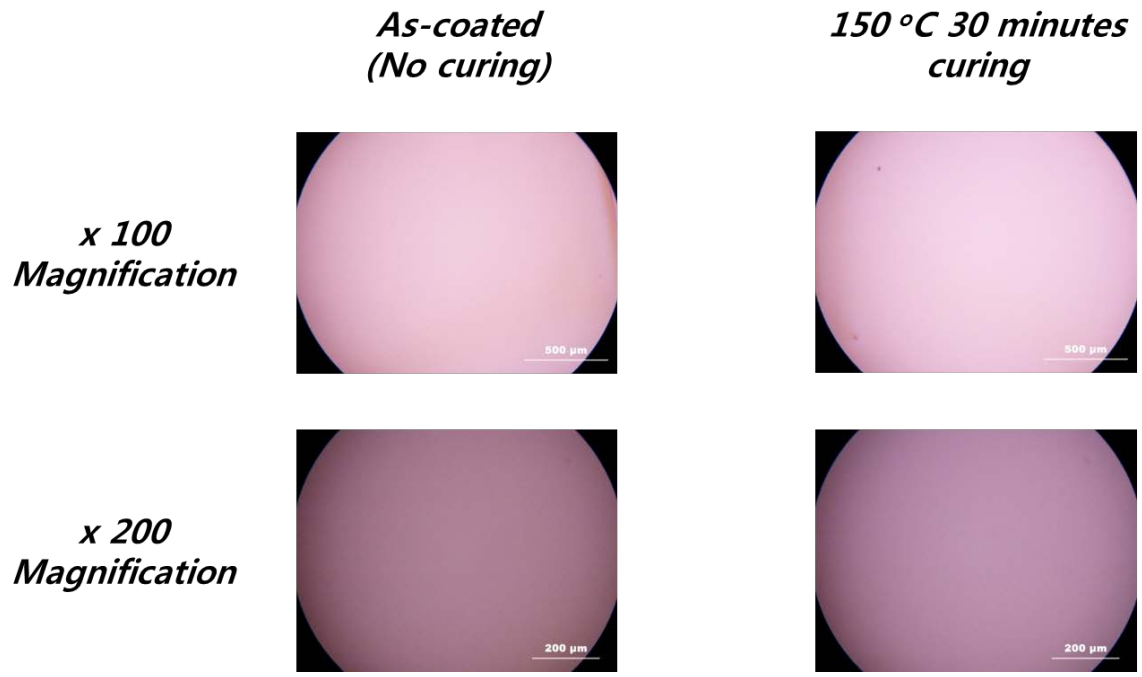
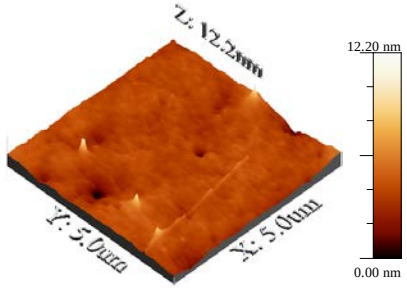
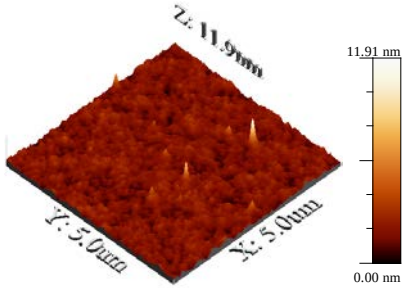
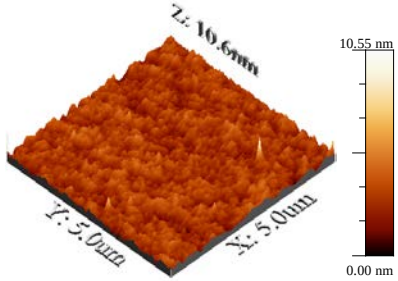
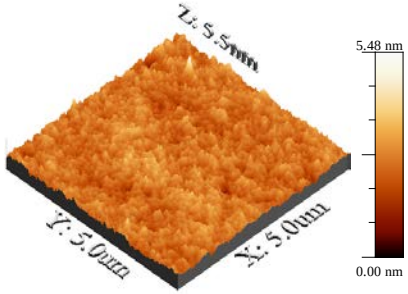
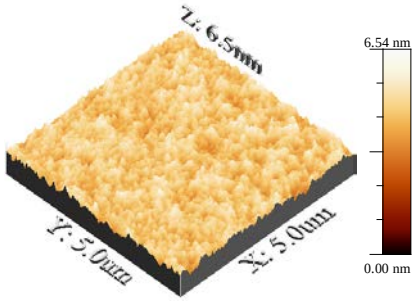
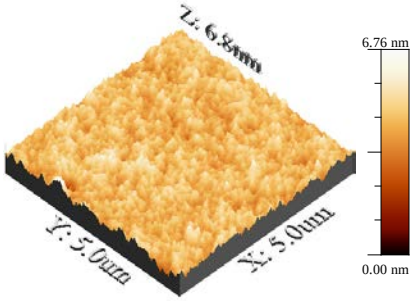


Fig. S12 AFM analysis results of the HTL films.

	Before curing	After curing	After washing
BCzMS	 RMS roughness : 0.62 nm	 RMS roughness : 0.56 nm	 RMS roughness : 0.75 nm
BCzBOS	 RMS roughness : 0.40 nm	 RMS roughness : 0.49 nm	 RMS roughness : 0.52 nm

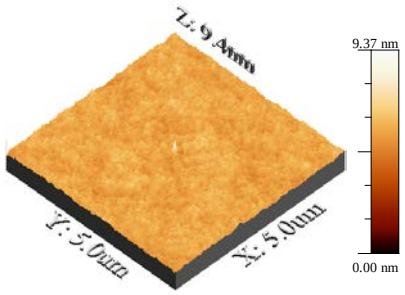
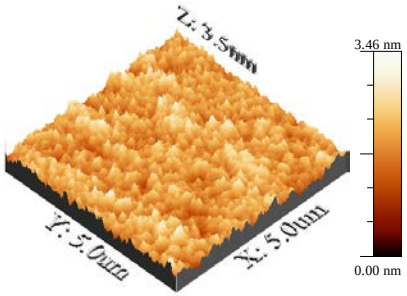
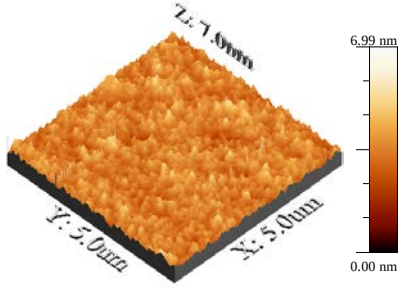
MeO-BCzBOS			
	RMS roughness : 0.34 nm	RMS roughness : 0.36 nm	RMS roughness : 0.50 nm

Fig. S13 External quantum efficiency graph of the HTL-containing OLED devices.

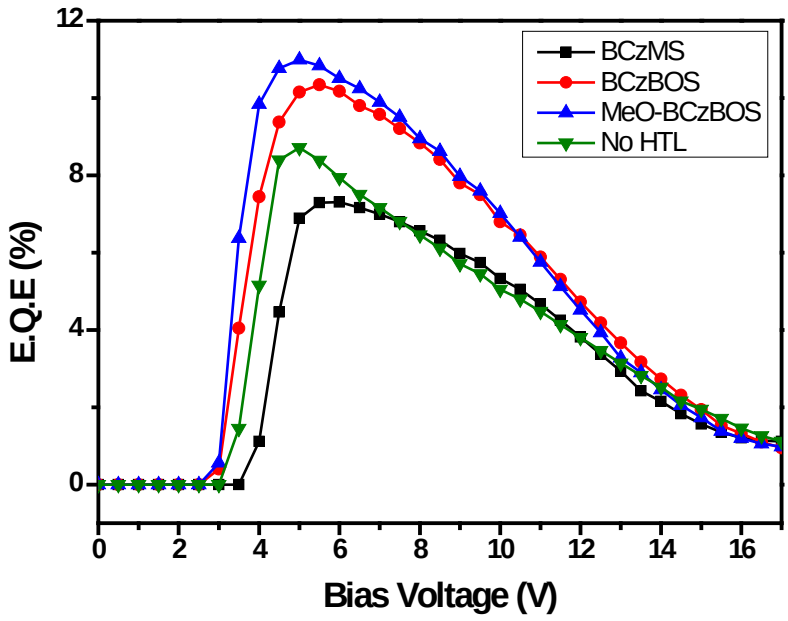


Fig. S14 Energy levels diagram for the devices.