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Electronic supplementary information (ESI) for:

Carbon dots dispersed hexabutyloxytriphenylene discotic mesogens: Structural, morphological and charge transporting behavior

Pruthvi Mahesh,[a] Asmita Shah,[b] K. Swamynathan,[a] Dharmendra Pratap Singh,*[b] Redouane Douali,[b] and Sandeep Kumar,*[a,c]

[a] *Soft condensed Matter, Raman Research Institute, Sadashiva nagar, Bangalore-560080, India.*

[b]*Univ. du Littoral Côte d'Opale, UR4476, UDSMM, Unité de Dynamique et Structure des Matériaux Moléculaires, F-62228, Calais, France.*

[c]*Deparment of chemistry, Nitte Meenakshi Instittue of Technology (NMIT), Yelahanka, Bangalore, India.*

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Synthesis of 2,3,6,7,10,11-hexabutyloxytriphenylene (HAT4) discotic liquid crystal (DLC):

Synthesis of compound 1: To the mixture of catechol (10g, 90.8 mmol, 1 eq), potassium carbonate (50.20g, 363.2 mmol, and 4eq) in acetone (100 ml), 1-bromobutane (27.37g, 199.7 mmol, 2.2 eq) was added. The mixture was refluxed for 48 hours and filtered upon cooling. The filtrate was extracted using dichloromethane, and the organic layer was washed with brine, dried over Na_2SO_4 and evaporated using the vacuum to obtain a crude product. The crude was then purified by the column chromatography using petroleum ether: dichloromethane (90:10) as eluent to get the desired product as a colorless liquid (80%). ^{1}HNMR (500 MHz, $CDCl_3$), δ(ppm) = 6.92 (s,4 H), 4.03 (t, J = 6.5 Hz, 4H), 1.83 (m, 4H), 1.54 (m, 4H), 1.01 (t, J = 7.5 Hz, 6H). ^{13}C NMR (500 MHz, $CDCl_3$), δ (ppm) = 149.3, 121.05, 114.3, 69.0, 31.4, 19.3, 13.9. Elemental analysis: C: 75.22; H: 10.22; (exp.); C: 75.63; H: 9.97 (cal.).

Synthesis of compound 2: Compound 1 (10g, 44.9 mmol, 1eq) was added dropwise to a solution of ferric chloride (21.84g, 134.7 mmol, 3eq) in dichloromethane (150 ml) and a catalytic amount of concentrated H_2SO_4. The mixture was stirred at room temperature for an hour and poured on to cold methanol (500 ml). The mixture then was kept inside the fridge for a few hours and the crude solid product was filtered and washed with ethanol. The crude was purified by the column chromatography using petroleum ether: dichloromethane (90:10) as eluent and recrystallized using ethanol to get white solid (72%). ^{1}H NMR (500 MHz, $CDCl_3$), δ(ppm) = 7.76 (s, 6H), 4.16 (s, 12H), 1.85 (m, 12H), 1.53 (m, 12H), 0.98 (m, J = 7.0 Hz, 18H). ^{13}C NMR (500 MHz, $CDCl_3$, δ (ppm) = 149.0, 123.6, 107.4, 69.4, 31.5, 19.4, 14.0. M. P. = 148 °C. Elemental analysis: C: 76.33; H: 9.15; (cal.); C: 76.15; H: 9.45; (exp.).

1. Fourier-transform infrared (FTIR) studies

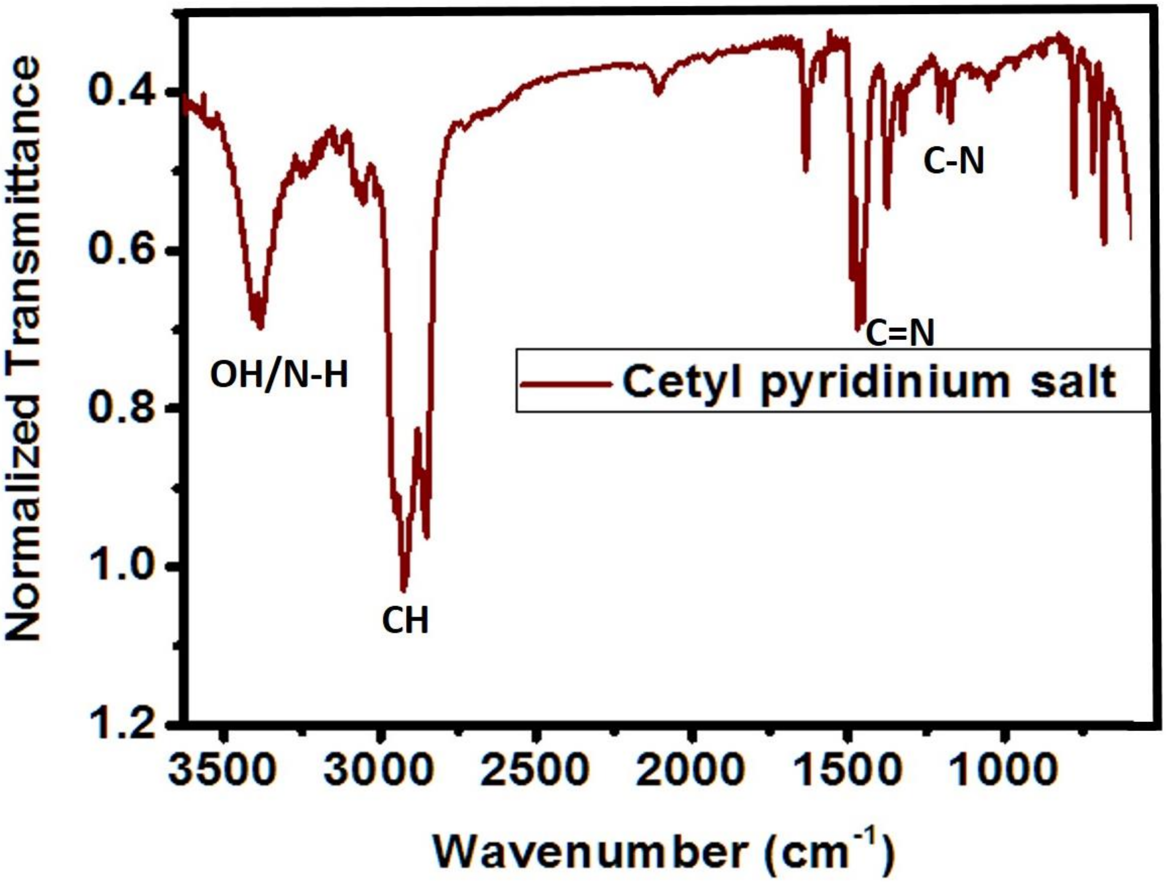

Fig. S1: FTIR spectrum of CPC.

The FTIR is in full agreement with the reported data [Ref. Zheng et al., RSC Adv., 2015, 5, 11667-11675 & Galgano et al. Journal of Colloid and Interface Science 361 (2011) 186–194]. Accordingly, the peak around 3400 cm^{-1} is attributed to the O-H/N-H stretching, whereas, the peaks at 2800-3000 cm^{-1} are attributed to the stretching vibration of C-H. Band at 1625 cm^{-1} is assigned to C=N stretching vibrations, respectively. The FTIR peak at 1020 cm^{-1} is attributed to C-N bending.

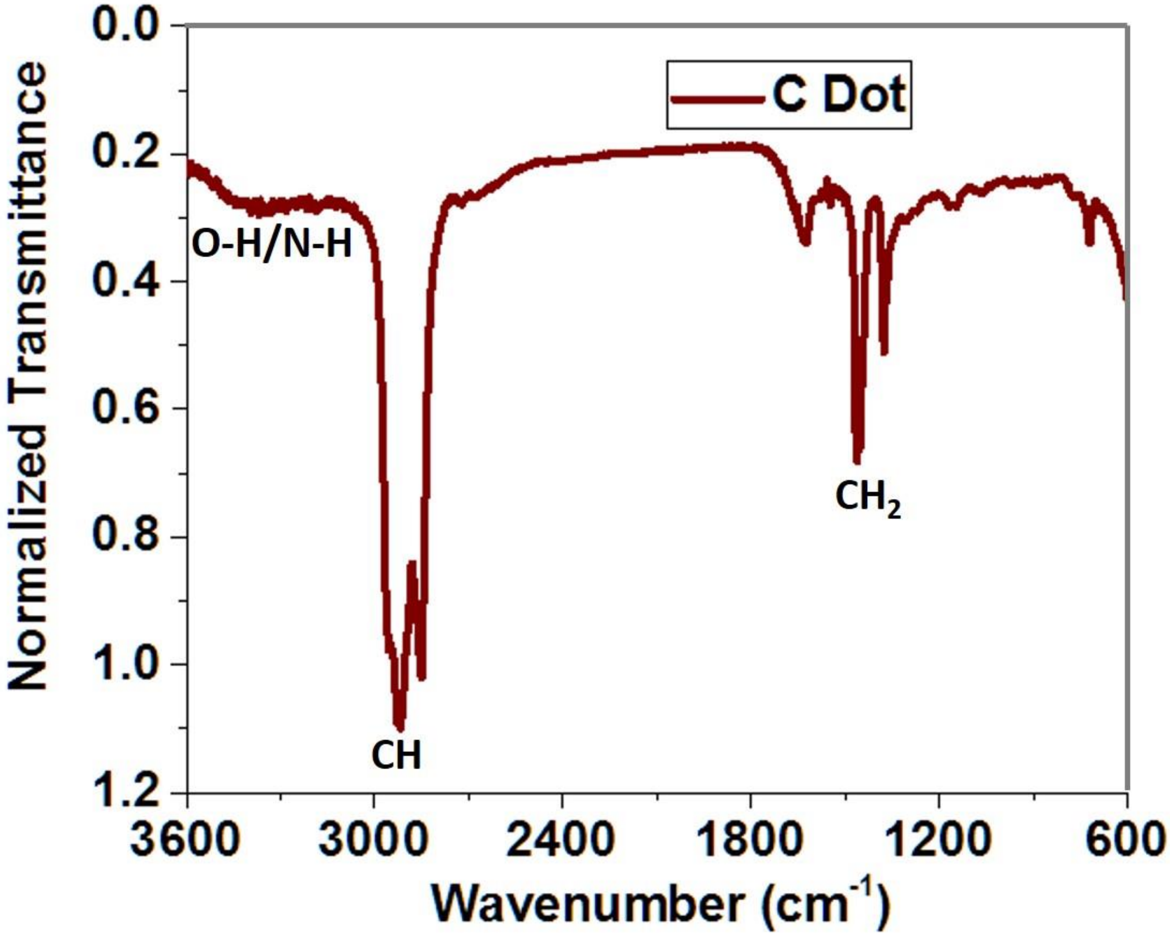

Fig. S2: FTIR spectrum of C-dots.

The FTIR is in full agreement with the reported data [Ref. Zheng et al., RSC Adv., 2015, 5, 11667-11675]. Accordingly, the peaks at 2850-2920 cm^{-1} are attributed to the stretching vibration of C-H, corresponding to CH_3 and CH_2 moieties in CPC, respectively. Bands at 1374-1467 cm^{-1} are assigned to CH_2 stretching vibration deformation. 3441 cm^{-1} peak is attributed to the O-H/N-H stretching.

2. Transmission electron microscopic (TEM) studies:

The TEM images show the organic soluble C-dots which are dispersed uniformly throughout. The average size was calculated to be ≈ 7-8 nm (in diameter).

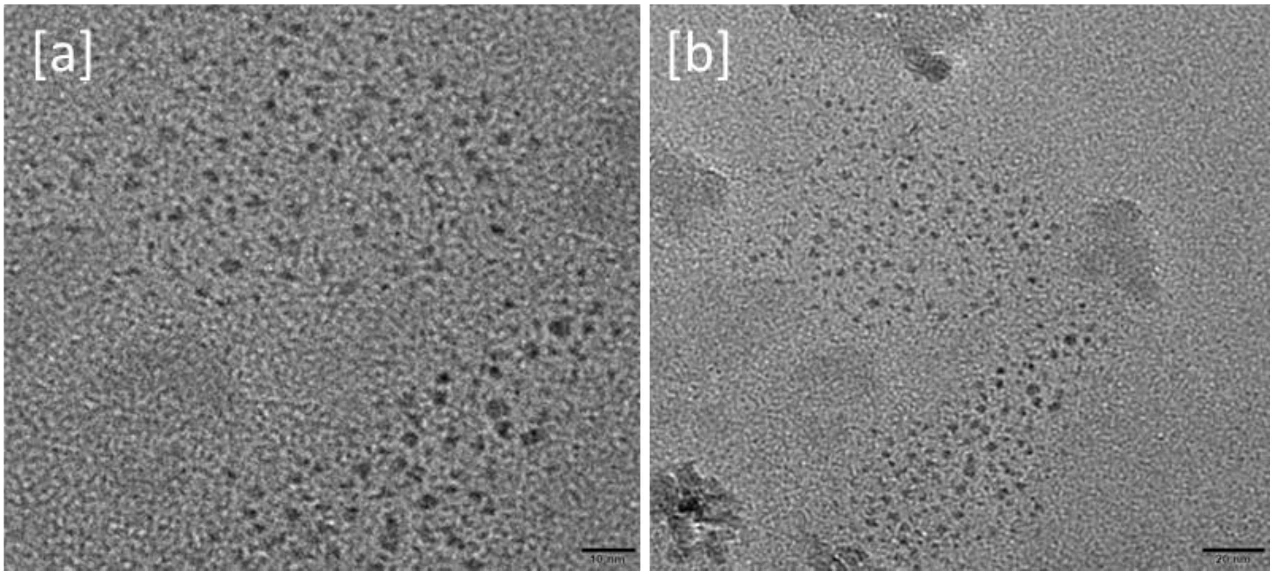

Fig. S3: TEM images of the organic soluble C-dots. Scale bars represent 10 and 20 nm, respectively, in figure S3 (a) and (b).

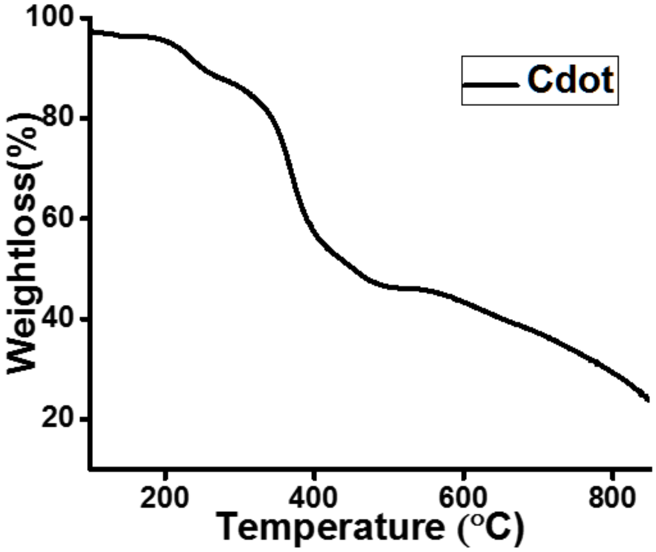

Fig. S4: TGA profile of the C-dots.

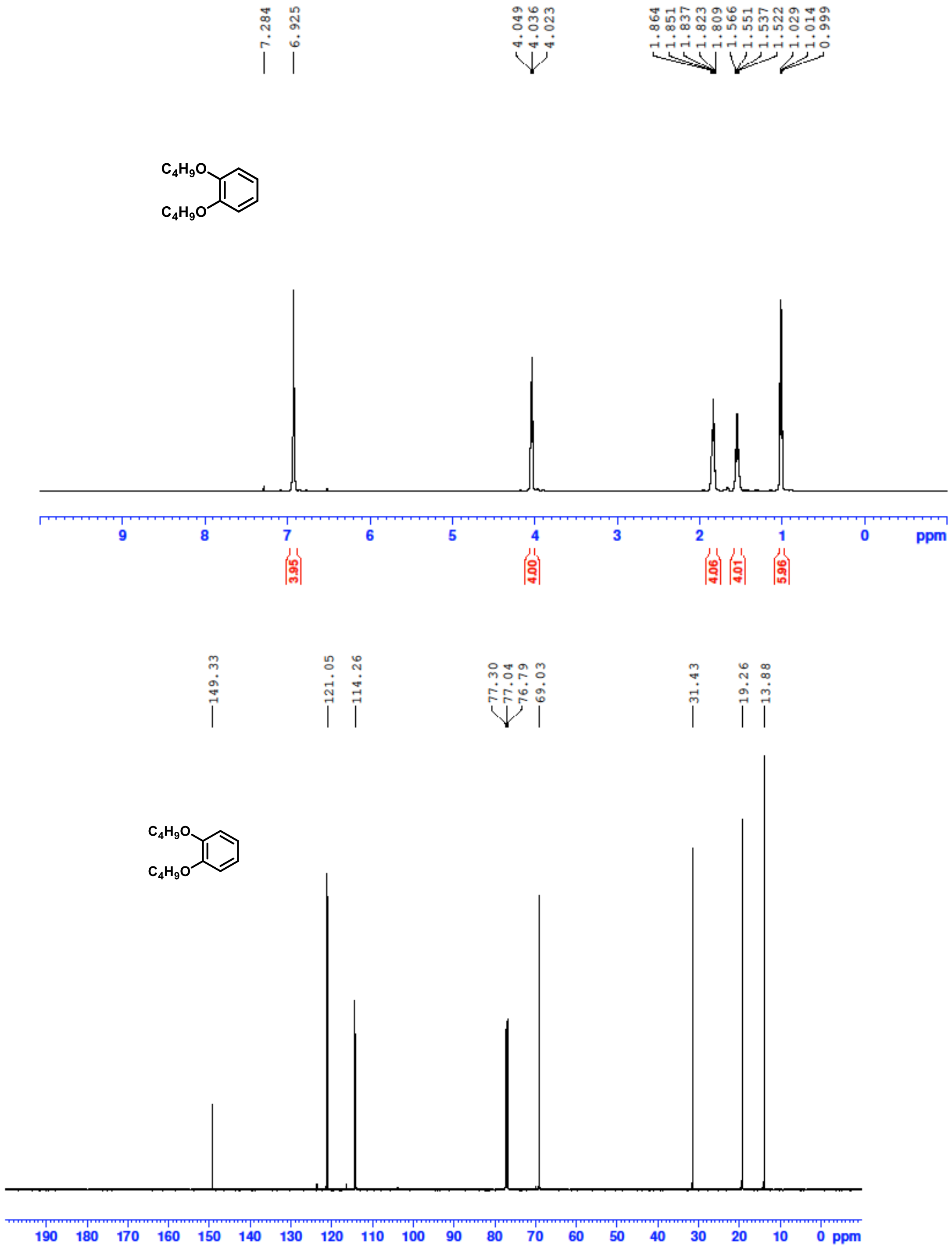

Fig. S5: ${}^{1}H$ NMR and ${}^{13}C$ NMR of compound **1**.

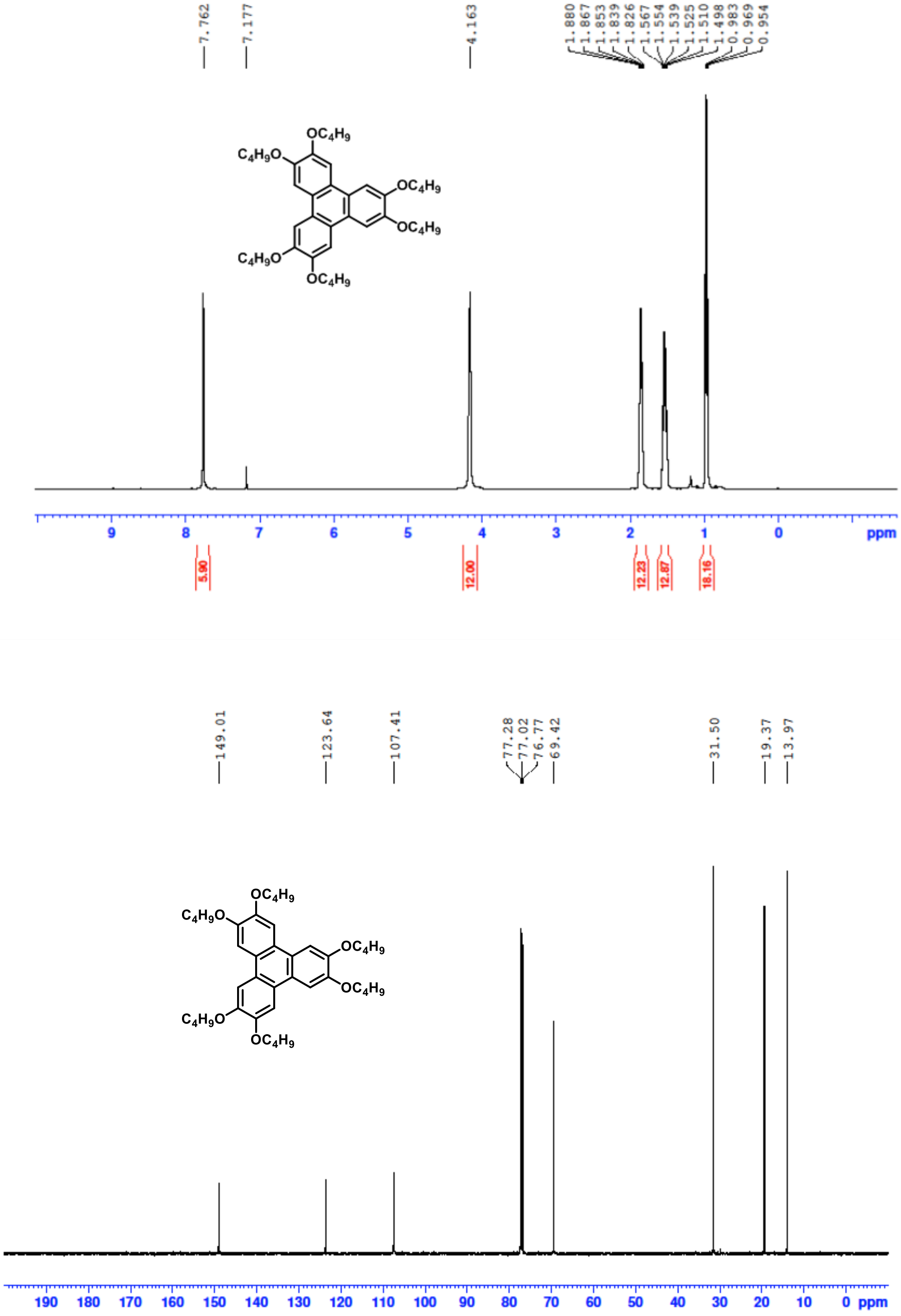

Fig. S6: ^{1}H NMR and ^{13}C NMR of compound **2**.

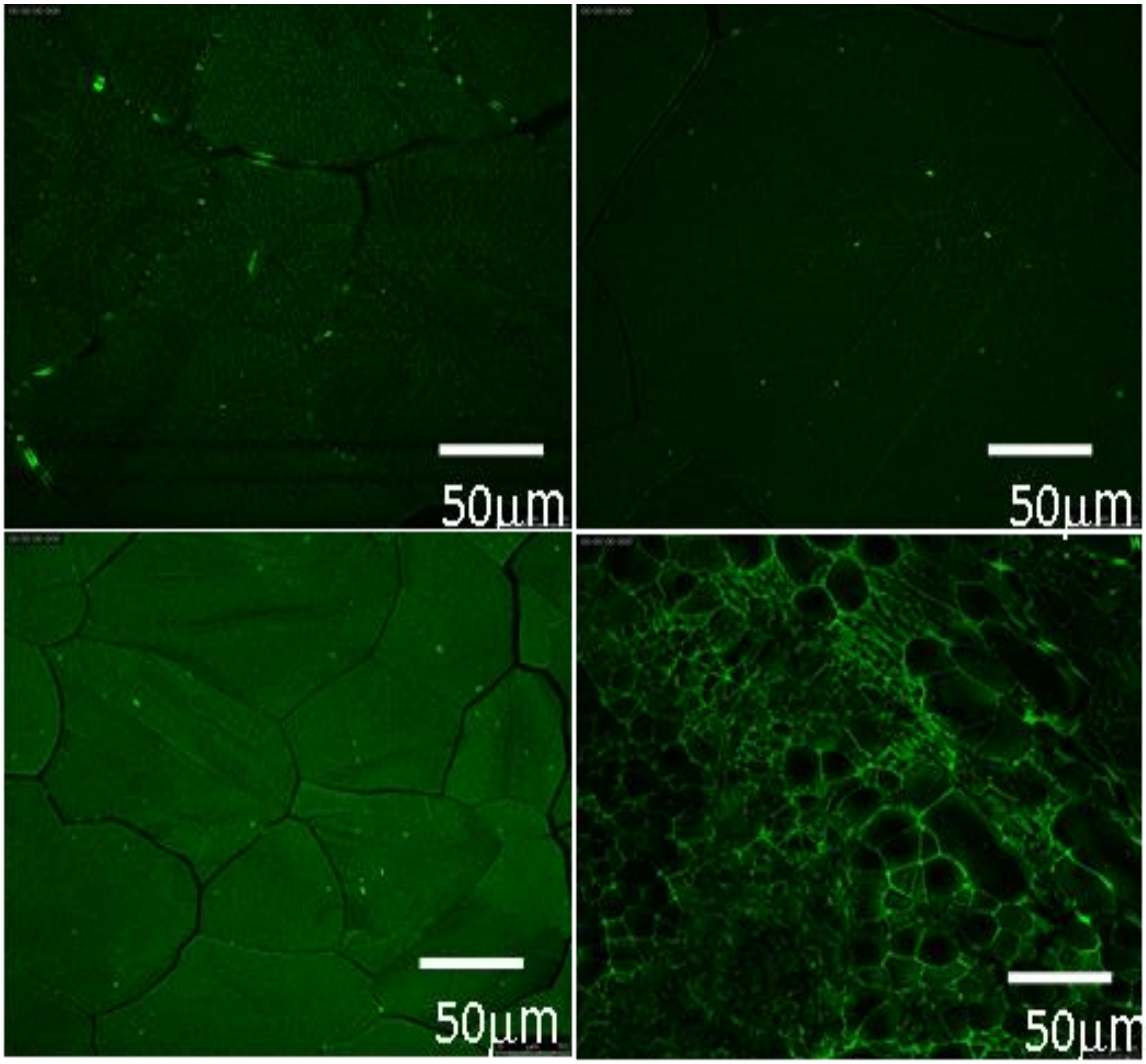

Fig. S7: Confocal microscopic studies of (a) 0.5 wt%, (b) 1 wt% , (c) 2 wt% and (d) 3 wt% C-dots dispersed HAT4 matrix.

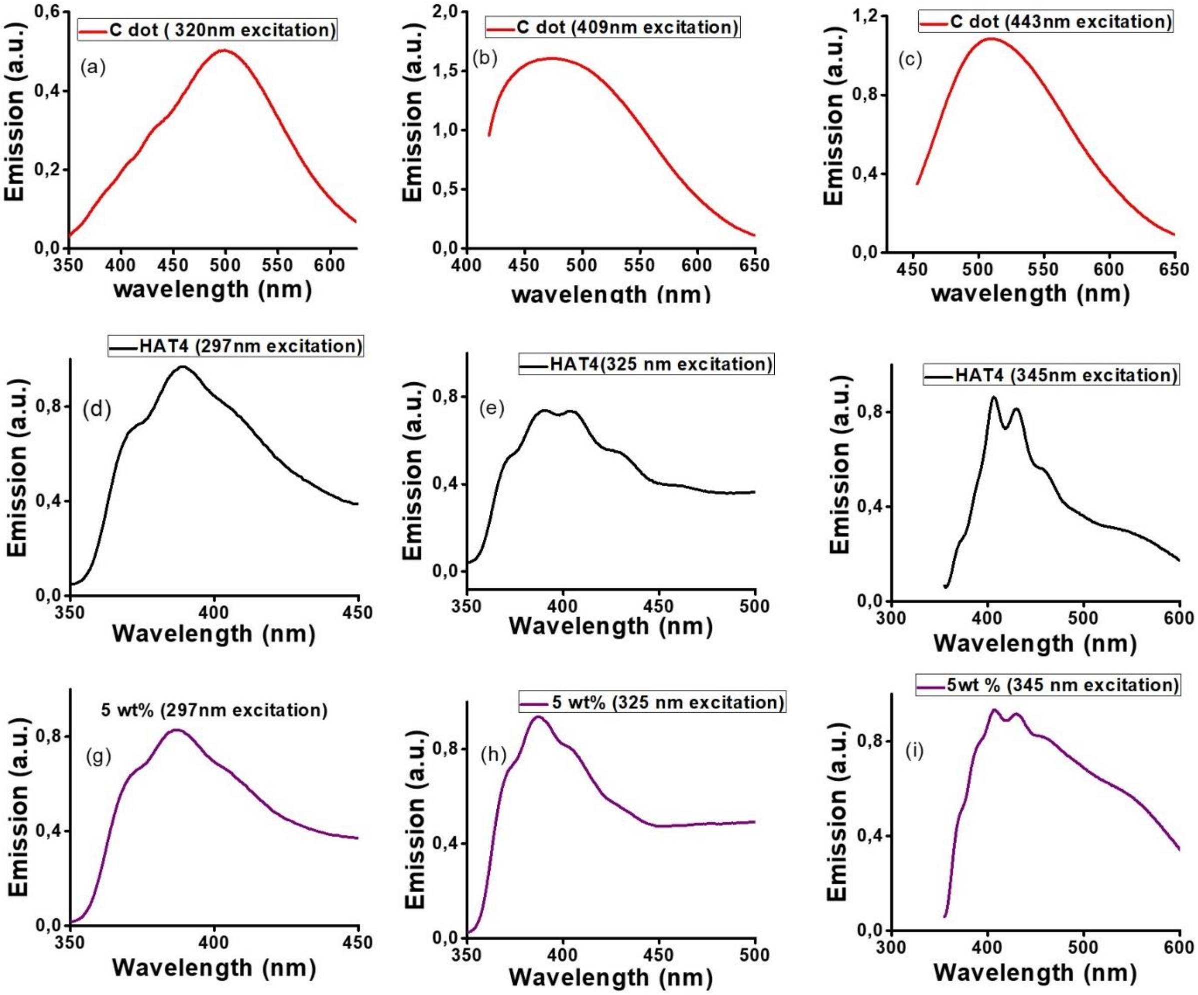

Fig. S8: Emission spectra of C-dots, HAT4 and 5wt% C-dots/HAT4 composite at different excitation wavelengths.

Compound **(wt%of C-dot)**	Phase sequence	
	Heating cycle	Cooling cycle
HAT4	Cr 91.07 (27.55) Col$_{hp}$ 145.32 (22.70) I	I 143.91 (-22.39) Col$_{hp}$ 80(-2.9)col$_{h}$ 41.1 (-9.53) Cr
0.5 wt% C-dots	Cr 81.47 (35.66) Col$_{hp}$ 144.96 (28.59) I	I 143.54 (-28.97) Col$_{hp}$ 79.81 Col$_{h}$(-3.35)
1 wt% C-dots	Cr 89.55 (21.79) Col$_{hp}$ 145.37 (21.70) I	I 143.03 (-22.09) Col$_{hp}$ 79.53 (-2.85) Col$_{h}$
2 wt% C-dots	Cr 90.42 (32.09) Col$_{hp}$ 144.71 (26.18) I	I 142.64 (-26.01) Col$_{hp}$ 79.76(-3.46) Col$_{h}$ 35.56(-2.98) Cr
3 wt% C-dots	Cr 90.77 (31.62) Col$_{hp}$ 144.39 (24.23) I	I 142.15 (-24.88) Col$_{hp}$ 79.61(-3.39) Col$_{h}$
5 wt% C-dots	Cr 91.11 (30.72) Col$_{hp}$ 143.98 (23.91) I	I 141.22 (-24.09) Col$_{hp}$79.59 (-3.38) Col$_{h}$

[a] Peak temperatures/°C (enthalpy/kJmol^{-1}) obtained by the second heating and first cooling at the rate of 5 °C/min; Col$_{h}$ = Columnar hexagonal phase; Col$_{hp}$ = Columnar hexagonal plastic phase I = Isotropic liquid phase.

Table S1. Thermal beahviour of Pristine HAT4 and C-dots/HAT4 composites. Phase transition temperatures (in °C) and the corresponding enthalpy changes (in kJmol^{-1}). Peak temperatures/°C (enthalpy/ kJmol^{-1}) obtained by the second heating and first cooling at the rate of 5 °C/min; Col$_{h}$ = Columnar hexagonal phase; Col$_{hp}$ = Columnar hexagonal plastic phase I = Isotropic liquid phase.

Compound (wt% of C dot)	**Phase (*T*/°C)**	**d_{obs} (Å)**	**d_{cal} (Å)**	**Miller Indices (*hkl*)**	**Lattice parameter *a* (Å),c (Å) Lattice area *S* ($Å^2$), Molecular volume *V* ($Å^3$)**
HAT4	Col_{hp} (120)	16.17	16.17	(100)	a = 18.672; c=7.09
		9.38	9.38	(110)	S = 301.925
		6.12	6.14	(210)	V = 1045.2655
		4.65	4.63	(211)	Z = 0.957
		3.57	3.54	(002)	
		3.49	3.46	(102)	
0.5 wt% C-dots	Col_{hp}(120)	16.25	16.25	(100)	*a* =18.764; c=7.046
		9.38	9.38	(110)	*S* = 304.907
		6.12	6.14	(210)	*V* = 1064.1287
		4.65	4.65	(211)	*Z* = 0.957
		3.57	3.54	(002)	
		3.49	3.46	(102)	
1 wt% C-dots	Col_{hp} (120)	16.17	16.17	(100)	*a* = 18.76; c=7.046
		9.34	9.38	(110)	*S* = 304.777
		8.09	8.12	(200)	*V* = 1063.6750
		6.11	6.14	(210)	*Z* = 0.969
		4.63	4.66	(211)	
		3.54	3.58	(002)	
		3.48	3.45	(102)	
2 wt% C-dots	Col_{hp} (120)	16.17	16.17	(100)	*a* = 18.76; c=7.046
		9.34	9.38	(110)	*S* = 304.777
		8.12	8.12	(200)	*V* = 1063.6750
		6.11	6.11	(210)	*Z* = 0.969
		4.65	4.65	(211)	
		3.58	3.54	(002)	
		3.49	3.45	(102)	
3 wt% C-dots	Col_{hp} (120)	16.17	16.17	(100)	*a* = 18.76; c=7.046
		9.34	9.38	(110)	*S* = 304.777
		8.08	8.12	(200)	*V* = 1063.6750
		6.11	6.12	(210)	*Z* = 0.969
		4.65	4.65	(211)	
		3.55	3.54	(002)	
		3.48	3.45	(102)	
5 wt% C-dots	Col_{hp} (120)	16.28	16.28	(100)	*a* = 18.76; c=7.046
		9.38	9.38	(110)	*S* = 304.777
		6.11	6.12	(210)	*V* = 1063.6750
		4.65	4.65	(211)	*Z* = 0.969
		3.58	3.54	(002)	
		3.49	3.46	(102)	

d_{obs} , experimental lattice spacing; d_{cal}, calculated from the lattice parameter, *a* for the hexagonal lattice; h_a, alkyl chains correlation peak value; h_c, core-core spacing; *Z*, number of molecules per columnar slice; *S*, lattice area; *V*, molecular volume

Table S2. XRD indexing data. d_{obs} , experimental lattice spacing; d_{cal}, calculated from the lattice parameter, a and c, the hexagonal lattice parameters; Z, number of molecules per columnar slice; S, lattice area; V, molecular volume.

Composite (wt% of C-dots)	**Conductivity(S/m)**		
	Cr (80 ^{o}C)	**Col$_{hp}$(120 ^{o}C)**	**Iso (150^{o}C)**
HAT4	4.00×10^{-9}	1.40×10^{-8}	1.60×10^{-8}
0.5 wt% C-dots	1.47×10^{-6}	3.53×10^{-7}	4.25×10^{-7}
1 wt% C-dots	1.87×10^{-6}	1.88×10^{-6}	2.00×10^{-6}
2 wt% C-dots	2.89×10^{-6}	2.91×10^{-6}	3.81×10^{-6}
3 wt% C-dots	5.84×10^{-6}	5.87×10^{-6}	7.01×10^{-6}
5 wt% C-dots	9.00×10^{-6}	9.33×10^{-6}	12.6×10^{-6}

Table S3. Conductivity values of HAT4 DLC and its composites with C-dots in the different phases. The conductivity of all compounds was calculated during the heating cycle.