Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting information

Self-cleaning and fully polymer-based super moisture-resistant gas barrier coating films with 2D polymer for flexible electronic devices and packaging applications

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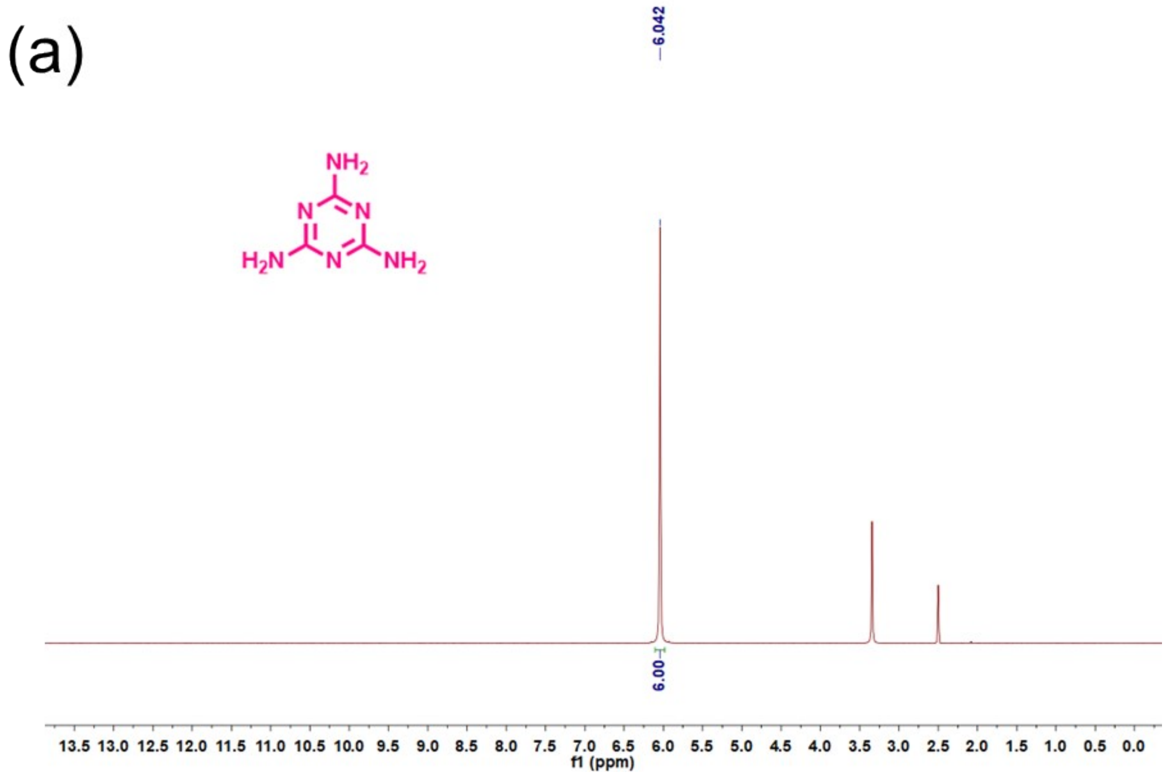
1. Synthesis and characterization of 2D polymer



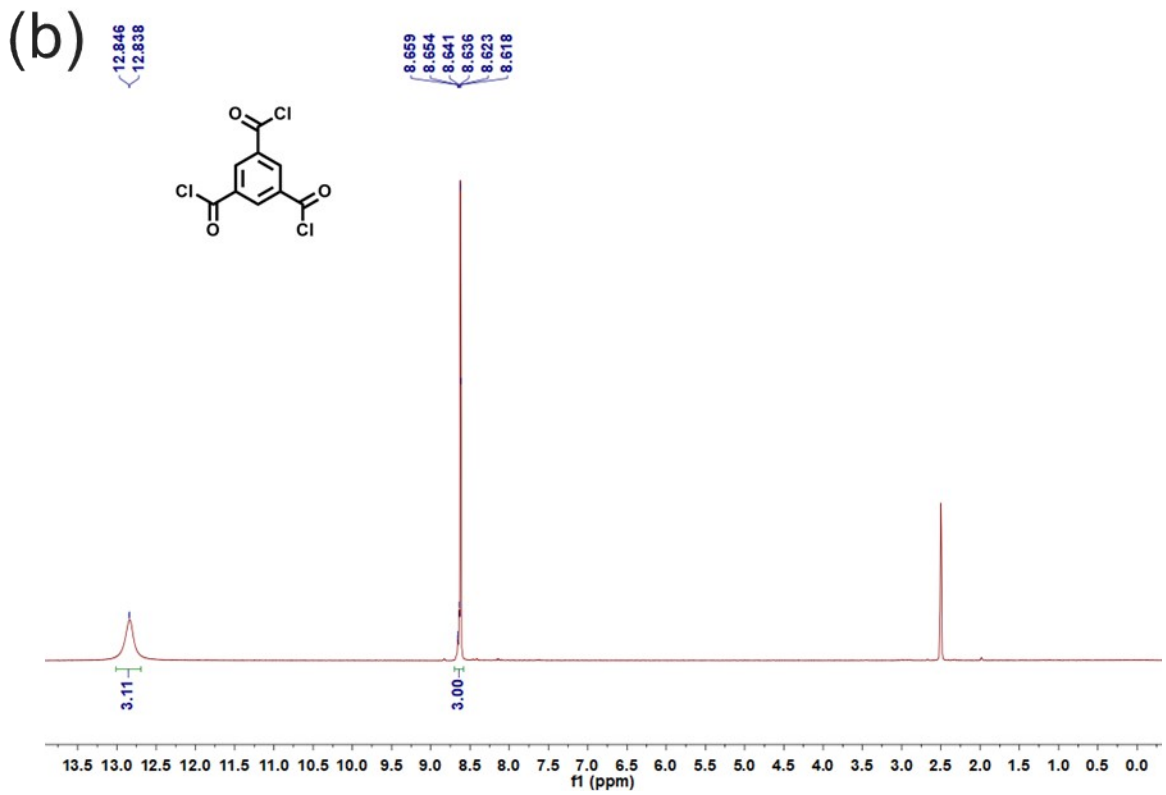


Fig. S1 ^{1}H NMR spectrum (500 MHz, 298K, DMSO-d_6) of monomers (a) melamine and (b) trimesic acid trichloride.

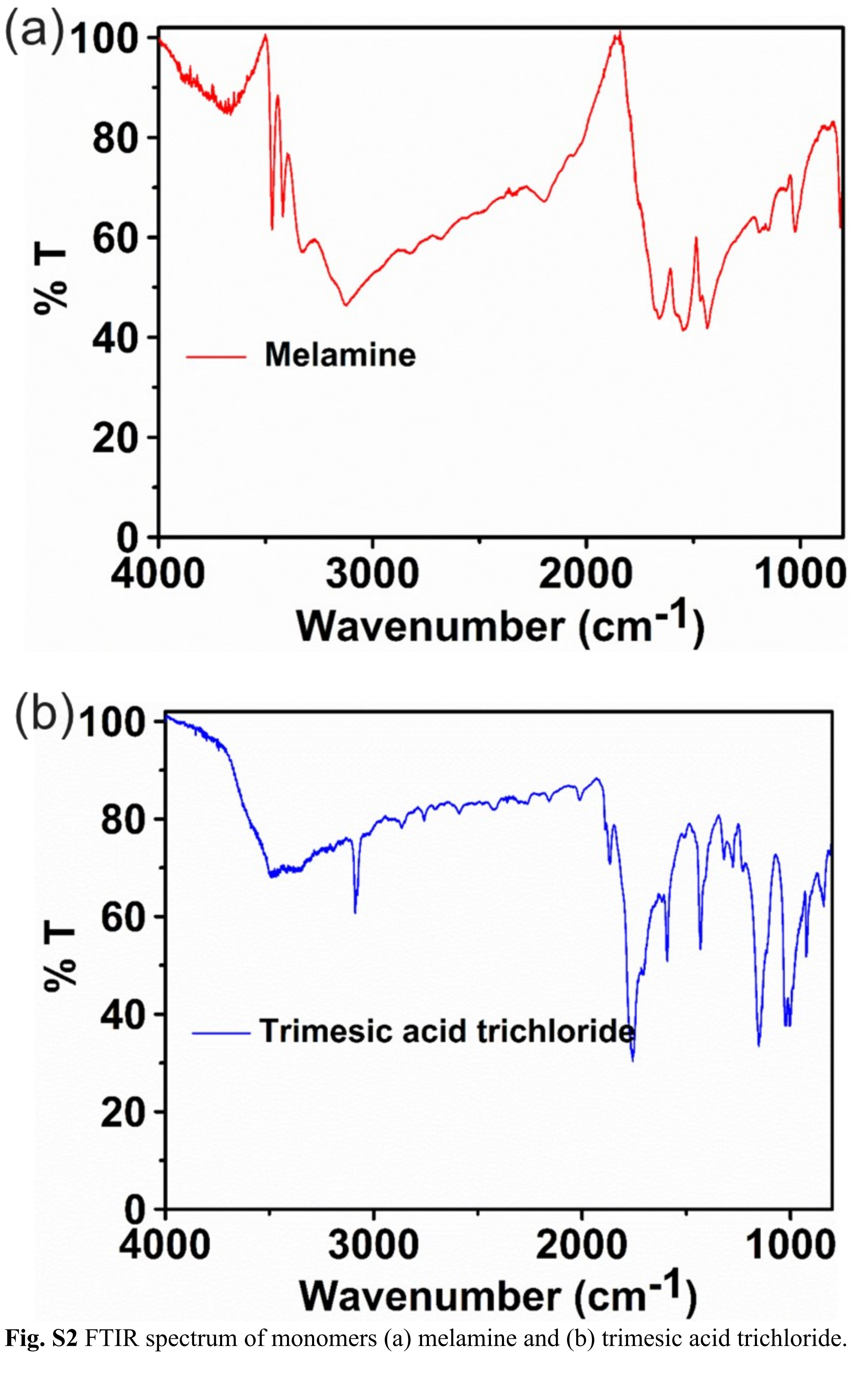


Fig. S2 FTIR spectrum of monomers (a) melamine and (b) trimesic acid trichloride.

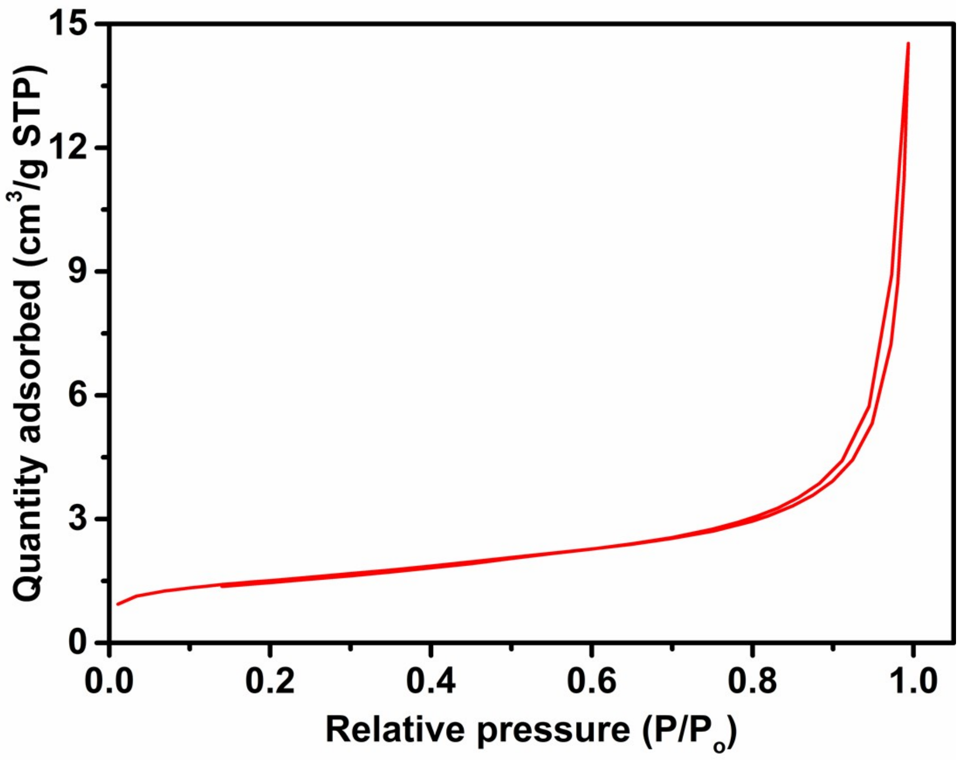


Fig. S3 BET adsorption-desorption curves of 2D polymer.

2. Characterization of 2D polymer and $(BL)_n$ films

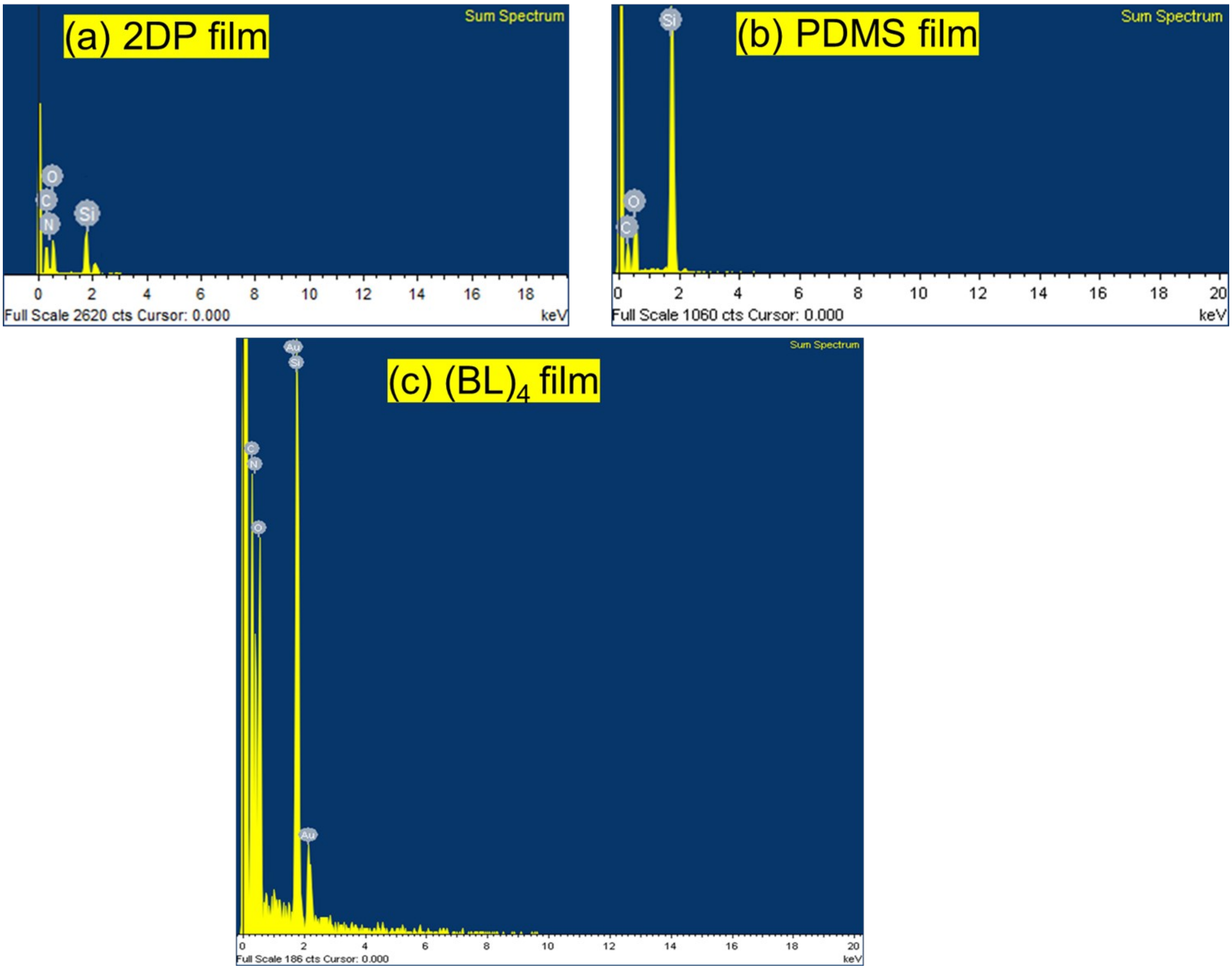


Fig. S4 EDX profile of (a) 2DP, (b) PDMS, and (c) $(BL)_4$ films.

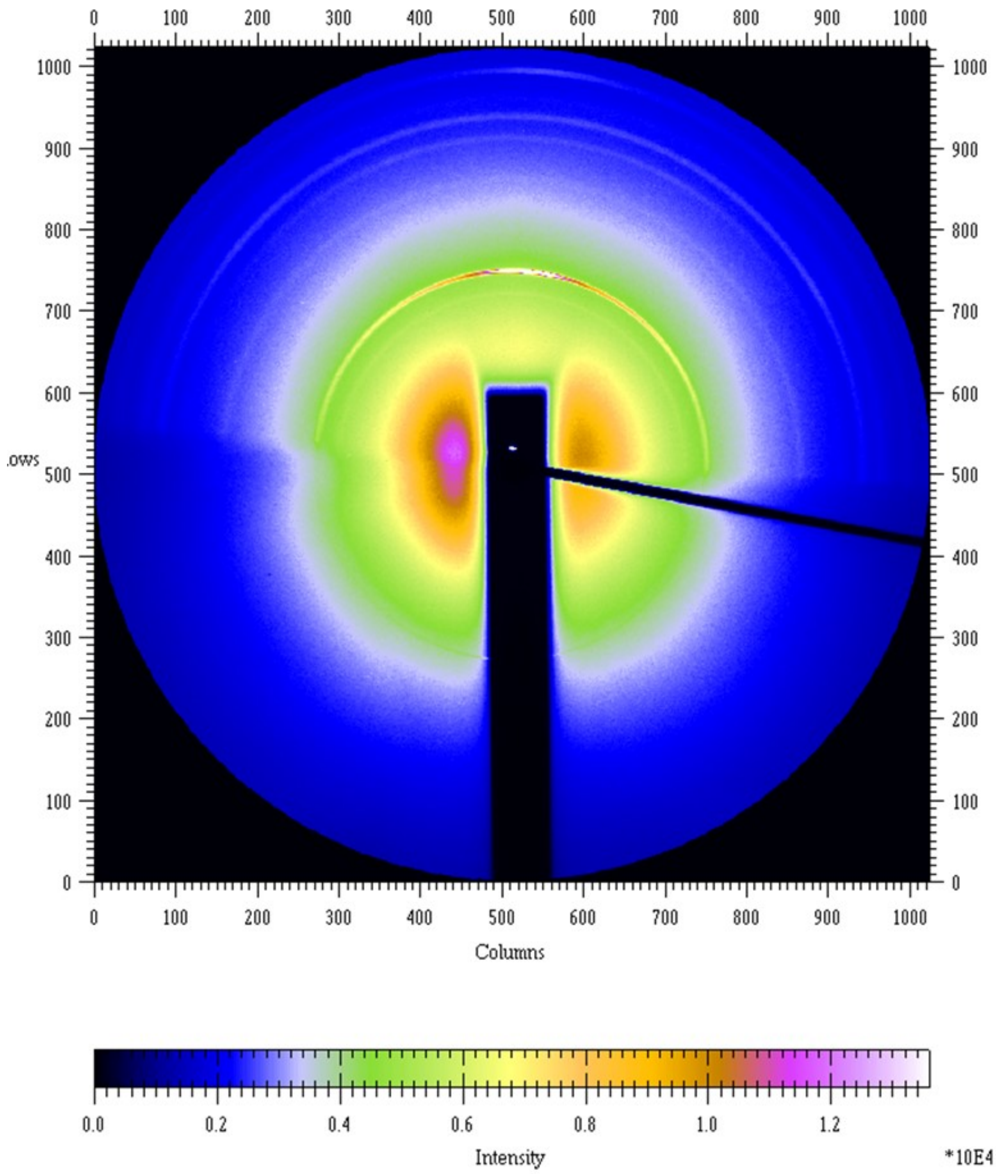


Fig. S5 2D profile of 2DP film obtained using GIWAXS.

3. Gas barrier properties

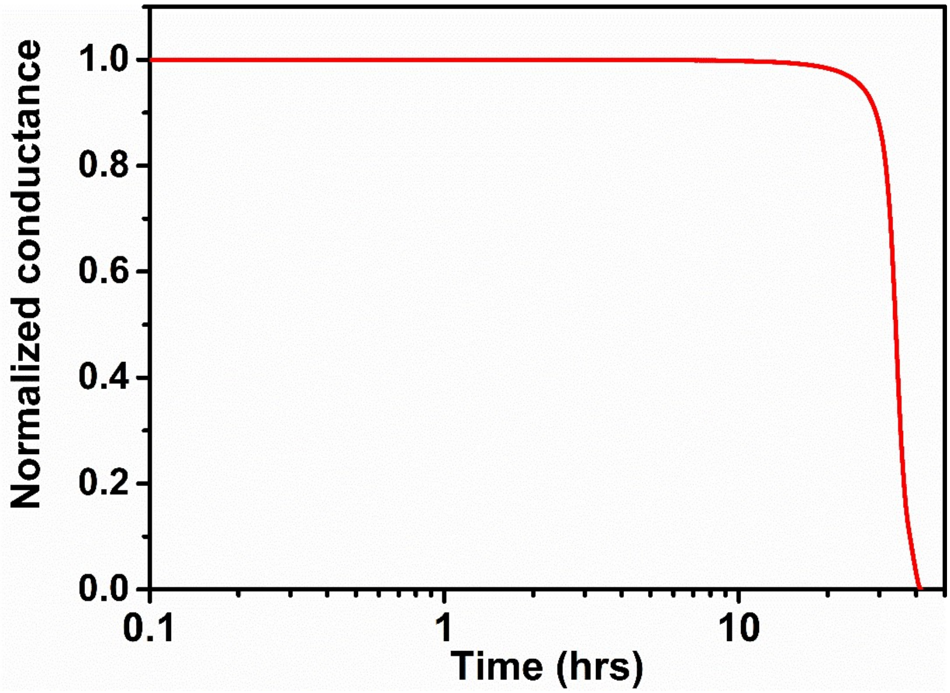


Fig. S6 Graphic plot of normalized conductance vs. time for SB-PDMS/PET/$(BL)_4$.

Table S1. Barrier Properties of Gas-Diffusion-Barrier-Films (GDBFs)

GDBFs	Lag Time [a] (hours)	Ca Sensor Lifetime (hours)	WVTR ($g\ m^{-2}\ day^{-1}$)
PET	0.2	1	1.4
PET/2DP	5	12	$4.0*10^{-2}$
PET/$(BL)_1$	11	14	$9.0*10^{-3}$
PET/$(BL)_2$	15	22	$6.0*10^{-3}$
PET/$(BL)_4$	23	35	$9.0*10^{-4}$
SB-PDMS/PET/$(BL)_4$	25	37	$8.5*10^{-4}$

[a] Lag time: The initial region in the normalized conductance vs. time graph where the conductivity does not change with time.

Table S2. GDBF Performances (WVTR Values) Reported in Literature

GDBFs	WVTR (g m^{-2} day^{-1})	Film Thickness	Temperature (°C) & Relative Humidity (RH)	References
PI/PDMS	1	38 μm/130 nm	40°C & 90 % RH	1
$PP/(LDH/PSS)_{30}$	$1.6 * 10^{-1}$	179 μm/65 nm	23 °C & 100 % RH	2
PET/PU-Na-hec nanocomposite	$<5 * 10^{-2}$	100 μm/1.5 μm	25 °C & 50 % RH	3
$PET/(PEI/VMT)_{20}$	$6.5 * 10^{-1}$	179 μm /160 nm	23 °C & 100 % RH	4
$PET/(LDH\text{-}80/PDMS)_{15}$	$5 * 10^{-2}$	N.A/12.95 μm	N.A	5
APTES@LDH(10%)/PLA	$2.6 * 10^{-2}$	60 μm	30 °C & 90 % RH	6
$PET/(PDDA/h\text{-}BN)_{30}$	$1.3 * 10^{-2}$	179 μm/130.6 nm	23 °C & 50 % RH	7
$PES/(PEI/PMA/PEI/MTM)_{5}$	$3.8 * 10^{-2}$	100 μm /50 nm	20 °C & 60 % RH	8
PET/PVA-LDH nanocomposite	$4 * 10^{-2}$	12 μm/1.1 μm	23 °C & 50 % RH	9
$PEN/PDDA(GO)/PVA(MMT)_{10}$	$3 * 10^{-3}$	125 μm/143 nm	23 °C & 50 % RH	10
$BOPP/(PEI/VMT)_{30}$	1.4	17.8 μm/ 226 nm	23 °C & 100 % RH	11
PDMS/PDDA (GO)/PVA (MMT)	$2.5 * 10^{-2}$	300 μm/150 nm	23 °C & 50 % RH	12
$PET/(PEI/PAA)_{50}$		179 μm/19.5 μm	23 °C & 100 % RH	13
PUA_8PU_2-PDMS $PUA_8PU_2\text{-}PDMS/(HL)_8$ $PET/(HL)_8/PUA_8PU_2$-PDMS	1.5 $8 * 10^{-3}$ $7.1 * 10^{-3}$	125 μm 125/ 3 μm 123/3/1 μm	23 °C & 50 % RH	14
PET/2DP **$PET/(BL)_1$** **$PET/(BL)_2$** **$PET/(BL)_4$**	**$4*10^{-2}$** **$9*10^{-3}$** **$6*10^{-3}$** **$9*10^{-4}$**	**125 μm/400 nm** **125 μm/1.1 μm** **125 μm/1.1 μm** **125 μm/1.1 μm**	**23 °C & 50 % RH**	**This Work**

Abbreviations used in Table S2: Polydimethylsiloxane (PDMS), Polyimide (PI), Polyethylenimine (PEI), Polyethylene terephthalate (PET), Vermiculite (VMT), Poly(sodium-p-styrenesulfonate) (PSS), Layered double hydroxides (LDH), Polypropylene (PP), $Na_{0.5}$-fluorohectorite ($Na_{0.5}(Mg_{2.5}Li_{0.5})Si_4O_{10}F_2$, denoted as Na-hec), Polydiallydimethylammonium (PDDA), Polyurethane (PU),Graphene oxide (GO), Montmorillonite (MMT), Poly(vinyl alcohol) (PVA), Polyethylene naphthalate (PEN), 3-Aminopropyltriethoxysilane (APTES), Polylactic acid (PLA), LDH nanoplatelets modified by APTES (APTES@LDH), Montmorillonite (MTM), Hexagonal boron nitride (h-BN), Poly(methyl acrylic acid) (PMA), Biaxially oriented polypropylene (BOPP), Poly(ethersulfone) (PES), Amphiphilic surfactant (Tween 80) modified LDH nanoplatelets (denoted as LDH-80).

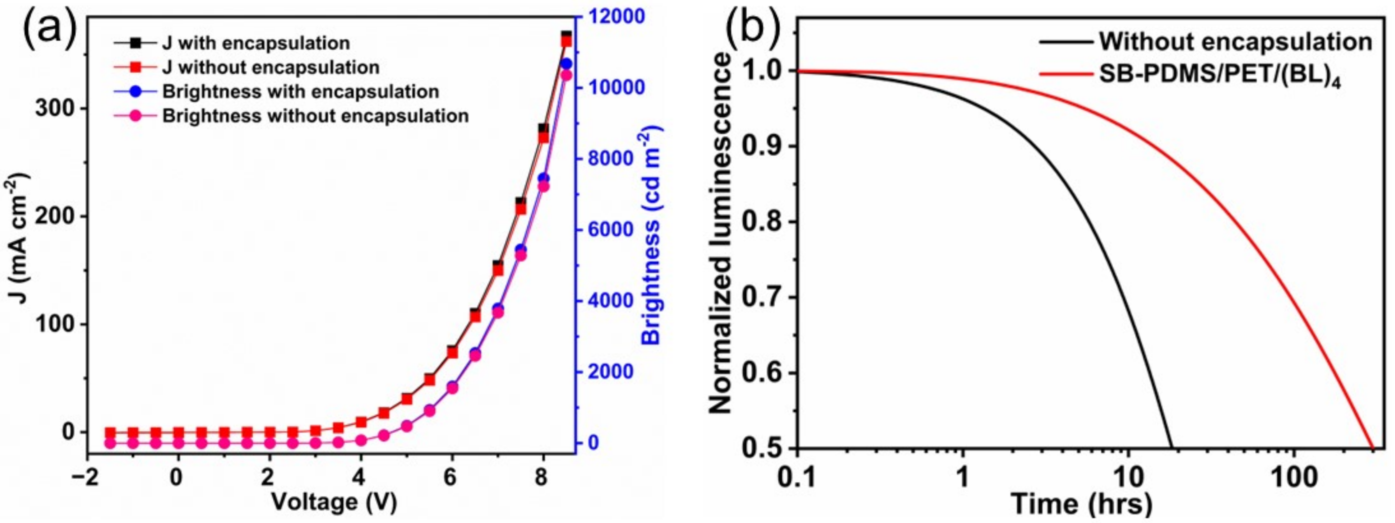


Fig. S7 (a) Initial performances (current density-voltage-luminescence (J-V-L) characteristics) of OLED devices with/without encapsulation and (b) Performance degradation curves of normalized luminescence (≈1000 Cd m^{-2}) versus continuous operation time (up to half-lifetime L_{50} ≈ 300 h) for OLED devices with/without encapsulation of SB-PDMS/PET/$(BL)_4$.

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