Electronic Supplementary Material (ESI) for Soft Matter.

Supplementary Information

Facile Preparation and Charge Retention Mechanism of Polymer-based Deformable Electret

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Table S1. Interaction energies in kJ mol^{-1} for stable H_3O^+-model molecule complexes. The numbering corresponds to the ones in Figure S2.

	1	2	3	4	5	6	7
Succinic anhydride	−205.4	−191.5					
Isopropyl succinic anhydride	−220.9	−207.0	−205.1	−187.5	−39.9	−21.2	−217.5
Butane	−72.6	−58.1					
2-Methylbutane	−77.0	−73.0	−76.4	−74.5	−73.2		
2,2-Dimethylbutane	−80.1	−78.5	−76.3	−72.3	−68.5	−75.3	

Table S2. Results of curve fitting analyses for crystalline components in the WAXS patterns. Units of the position and the full width at half maximum (FWHM) are in nm^{-1}.

		Crystal						
MPP	Position	10.02±0.00	11.97±0.00	13.17±0.00	14.96±0.00	15.46±0.00	17.95 ±0.00	20.16 ±0.01
	FWHM	0.41±0.00	0.29±0.00	0.40±0.00	0.43±0.00	0.53±0.00	0.48± 0.01	1.09± 0.02
PP	Position	10.03±0.00	12.00±0.00	13.19±0.00	14.99±0.00	15.49±0.00	17.99 ±0.00	20.22 ±0.00
	FWHM	0.37±0.00	0.28±0.00	0.37±0.00	0.43±0.00	0.48±0.00	0.38± 0.01	0.89± 0.01
PBl/MPP	Position	10.01±0.00	12.06±0.00	13.13±0.00	14.93±0.01	15.42±0.00		
	FWHM	0.28±0.00	0.34±0.00	0.38±0.00	0.39±0.01	0.61±0.01		
PBl/PP	Position	9.99±0.00	12.06±0.00	13.14±0.00	14.94±0.00	15.48±0.00		
	FWHM	0.25±0.00	0.26±0.00	0.27±0.00	0.35±0.00	0.41±0.00		
PBl/PP/ ODSA	Position	10.00±0.00	12.06±0.00	13.15±0.00	14.95±0.00	15.49±0.00		
	FWHM	0.25±0.00	0.25±0.00	0.27±0.00	0.33±0.00	0.40±0.00		

Table S3. Results of curve fitting analyses for amorphous components in the WAXS patterns. Units of the position and the full width at half maximum (FWHM) are in nm^{-1}.

		Amorphous
MPP	Position	12.49±0.00
	FWHM	6.26±0.01

PP	Position	12.38±0.01	
	FWHM	6.54±0.01	
PBl/MPP	Position	10.21±0.00	11.09±0.00
	FWHM	2.86±0.00	7.24±0.01
PBl/PP	Position	10.17±0.00	11.03±0.00
	FWHM	2.85±0.00	7.18±0.01
PBl/PP/ODSA	Position	10.24±0.00	11.15±0.00
	FWHM	2.95±0.00	7.17±0.01

Table S4. Crystallinity estimated from the WAXS analyses (see Figure S3). Crystallinity is defined as crystallinity = (total area of crystalline peaks)/(total area of crystalline and amorphous peaks).

	Crystallinity / %
MPP	41.4±0.1
PP	45.2±0.1
PBl/MPP	4.5±0.0
PBl/PP	5.2±0.0
PBl/PP/ODSA	5.0±0.0

Table S5. Periodic length (*d*) estimated from the SAXS patterns.

	d / nm
MPP	13.1±0.0
PP	14.0±0.0
PBl/MPP	-
PBl/PP	18.5±0.0
PBl/PP/ODSA	19.6±0.0

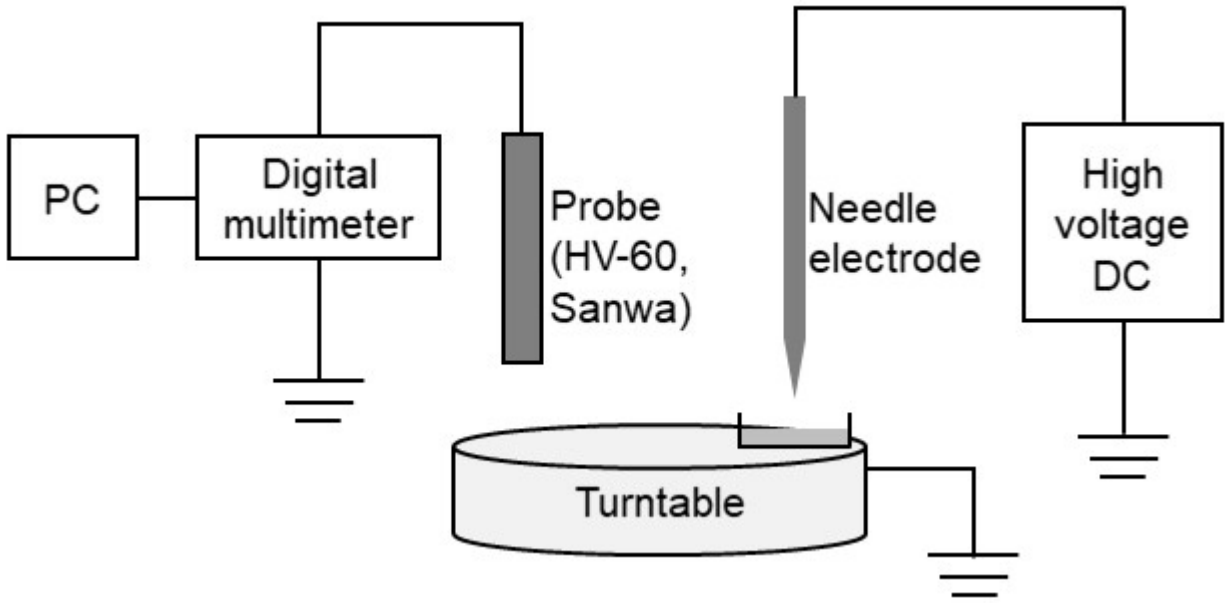
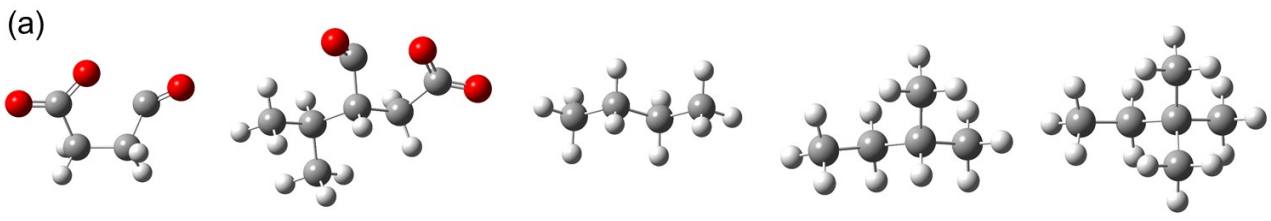


Figure S1. Measurement system for surface potential decay.

Figure S2. Appearance of the samples, PB/MPP, PB/ODSA, PB/PP, and PB/PP/ODSA from left to right. PB/MPP is in a pale yellow coming from the purchased MPP color.



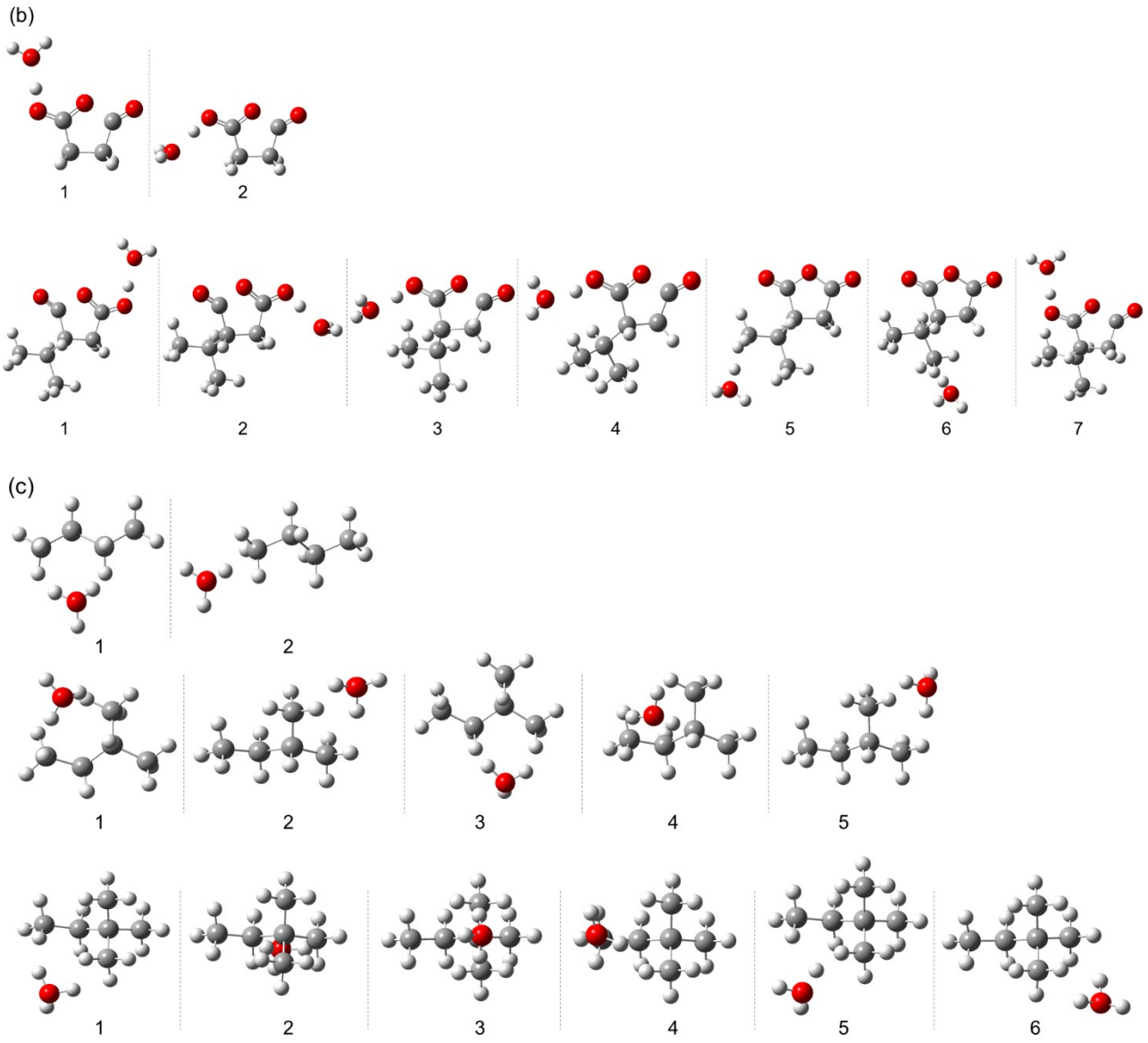


Figure S3. Calculated stable ion-model molecule complexes. (a) Electron-model molecules (i.e., anion radical), (b) H_3O^+-polar molecules, and (c) H_3O^+-nonpolar molecules.

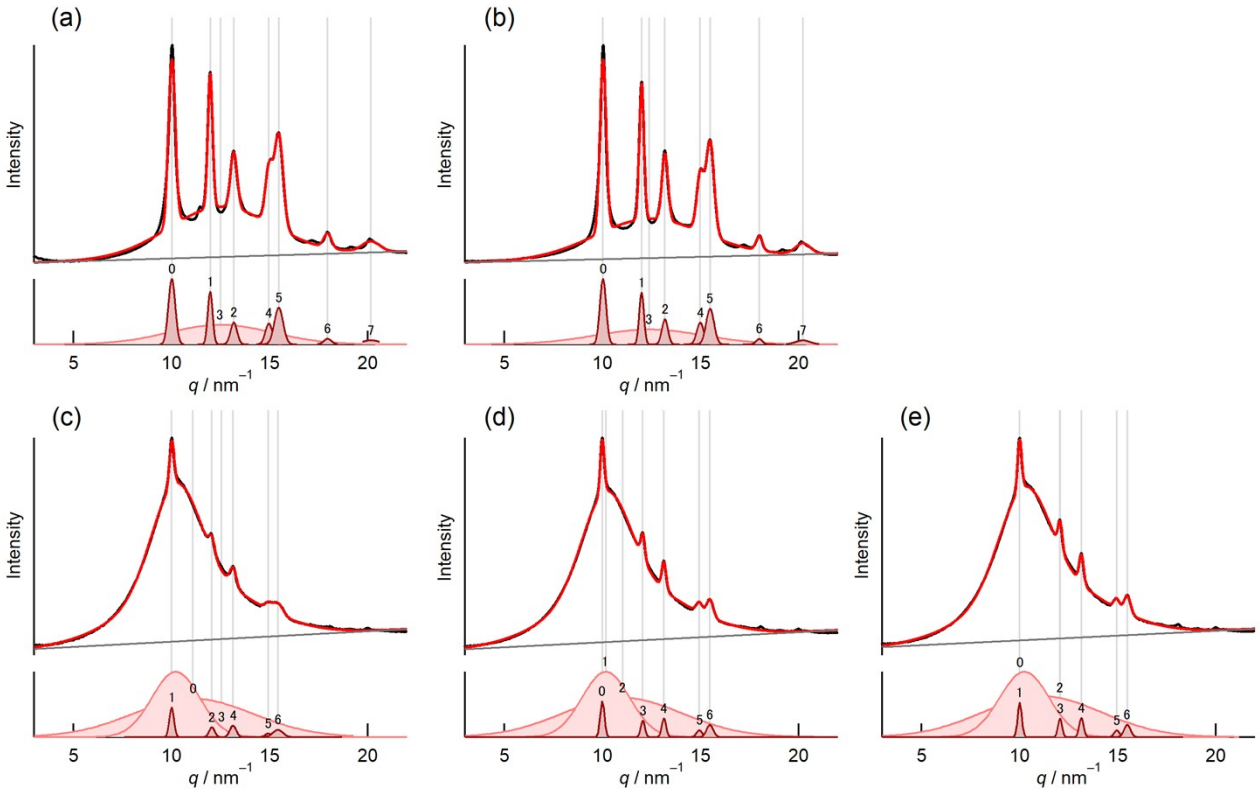


Figure S4. WAXS curve fitting analyses for (a) MPP, (b) PP, (c) PBl/MPP, (d) PBl/PP, and (e) PBl/PP/ODSA. Black and red lines are experimental and fitted patterns, respectively. Crystalline components represent in dark red whereas amorphous components are in pale red.

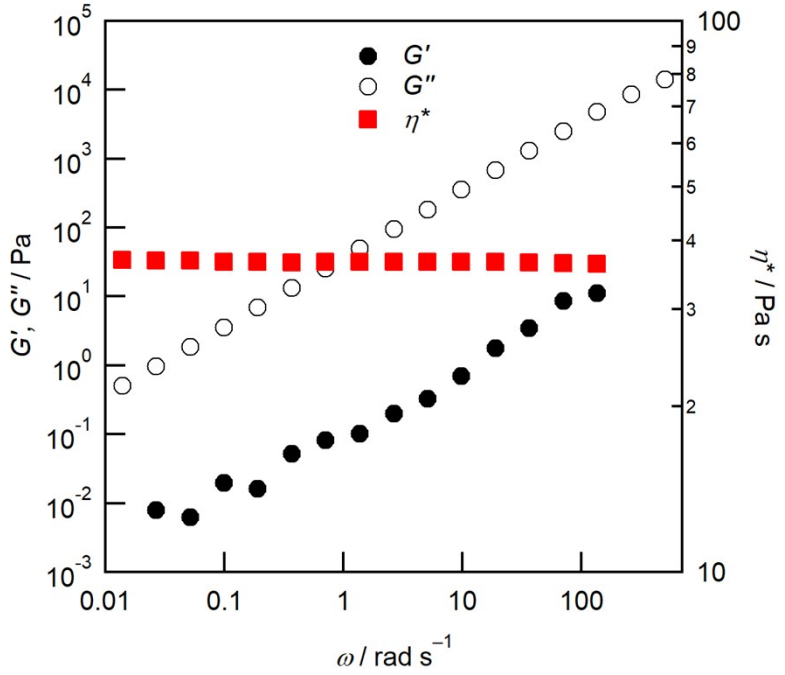


Figure S5. Storage modulus (G'), loss modulus (G''), and complex viscosity (η^*) of PBl.

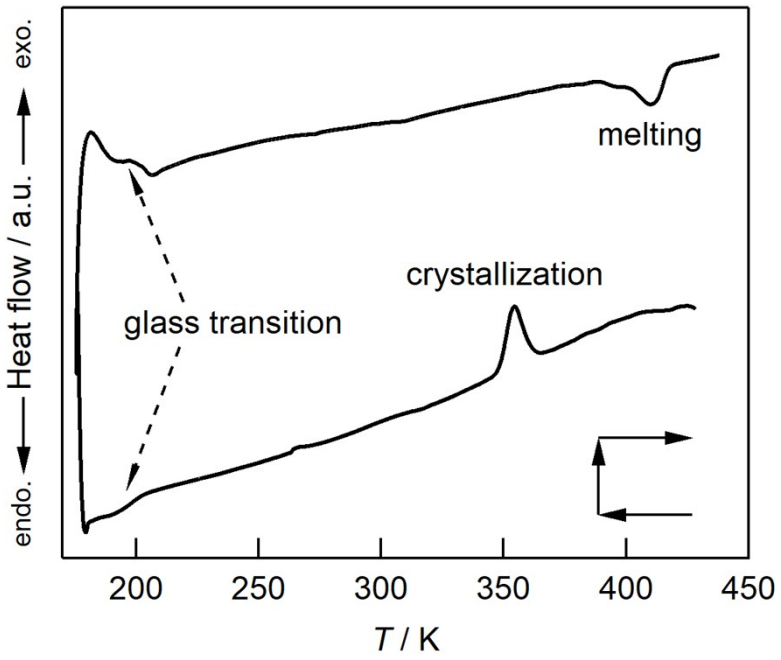


Figure S6. DSC traces of PBl/MPP. Measurements were started at 443 K and cooed at 10 K/min with a DSC7020 (Hitachi High-Tech Science). An exothermic peak at 354 K and an endothermic peak 410 K come from crystallization and melting of the polypropylene components, respectively.

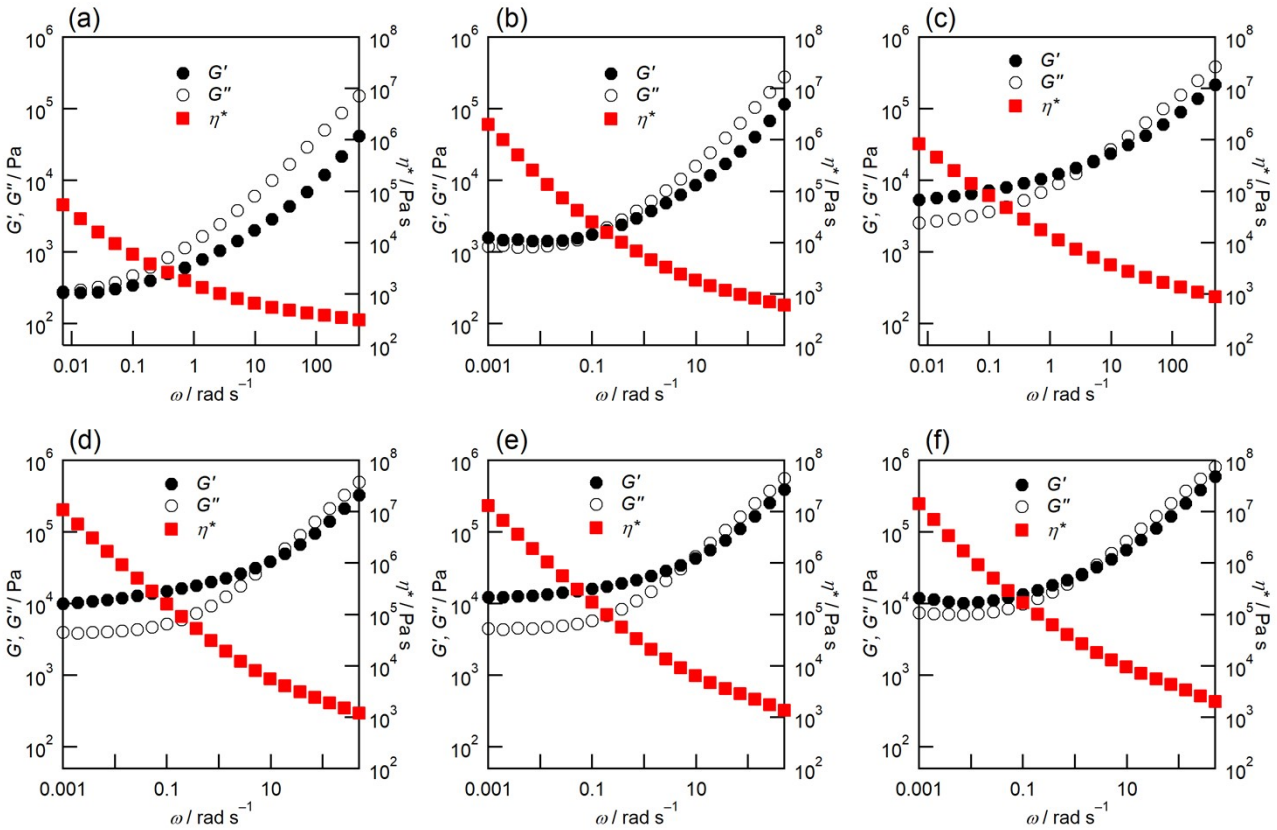


Figure S7. Storage modulus (G'), loss modulus (G''), and complex viscosity (η^*) of PBl/PBh/MPP where (a) PBl:PBh = 8:2, (b) PBl:PBh = 6:4, (c) PBl:PBh = 4:6, (d) PBl:PBh = 2:8, (e) PBl:PBh = 1:9, and (f) PBl:PBh = 0:10.

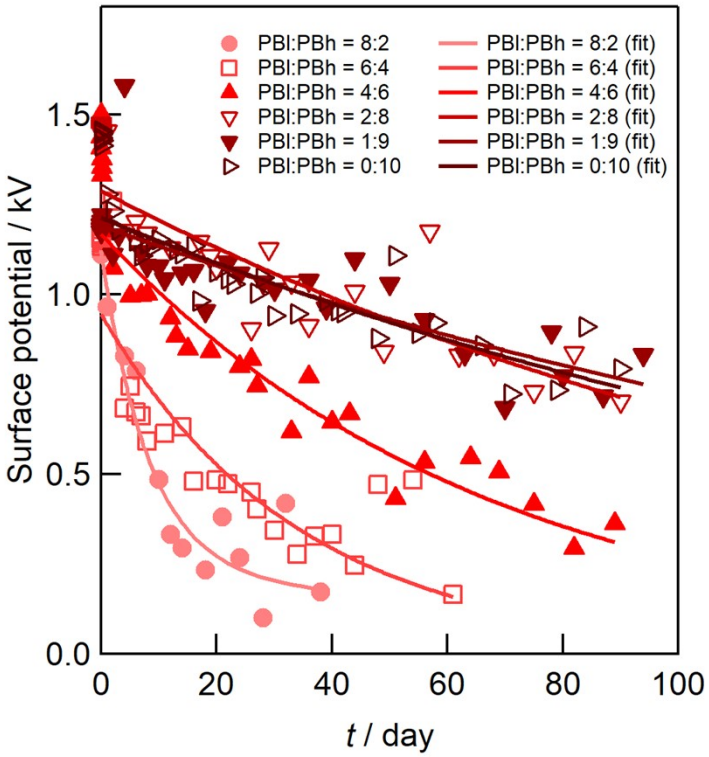


Figure S8. Surface potential decays of PBl/PBh/MPP where PBl:PBh = 8:2, PBl:PBh = 6:4, PBl:PBh = 4:6, PBl:PBh = 2:8, PBl:PBh = 1:9, and PBl:PBh = 0:10.

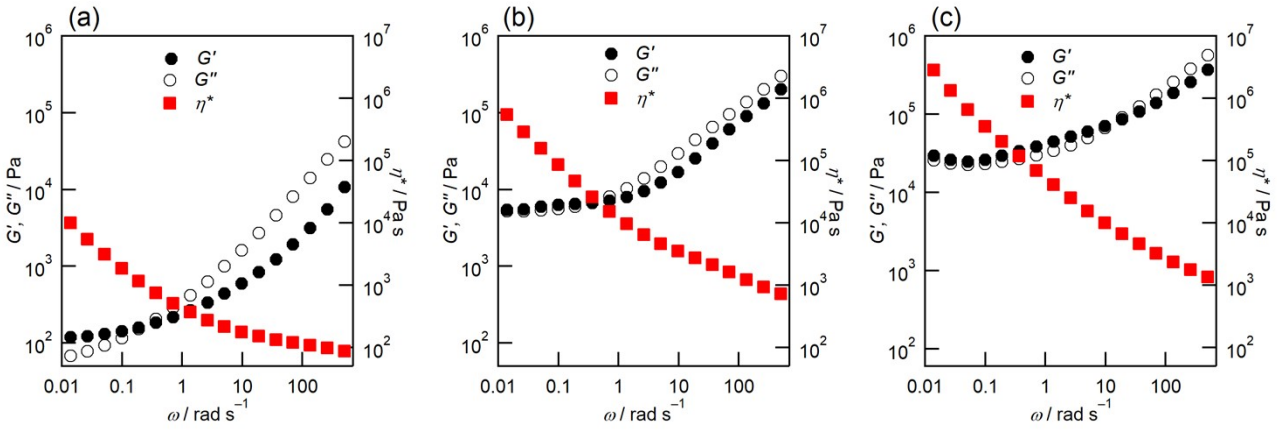


Figure S9. Storage modulus (G'), loss modulus (G''), and complex viscosity (η^*) of PBl/MPP with different MPP concentrations. (a) 5 wt%, (b) 20 wt%, and (c) 30 wt%.

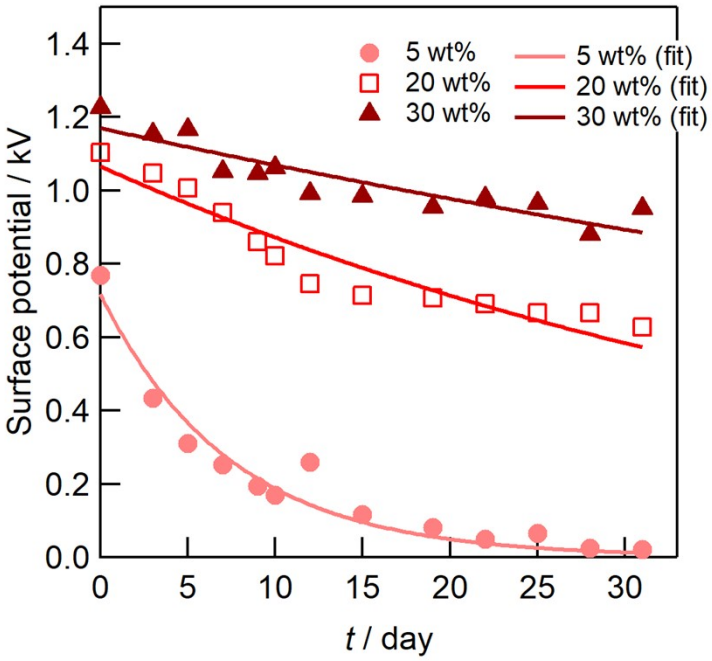


Figure S10. Surface potential decays of PBl/MPP with different MPP concentrations. (a) 5 wt%, (b) 20 wt%, and (c) 30 wt%.

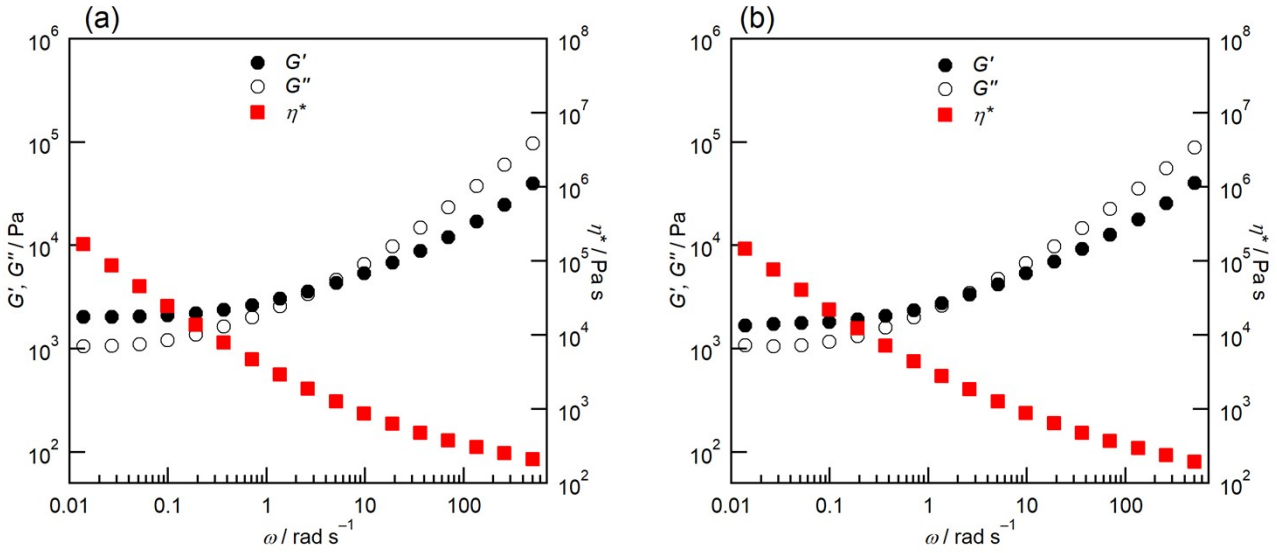


Figure S11. Storage modulus (G'), loss modulus (G''), and complex viscosity (η^*) of (a) PBl/PP and (b) PBl/PP/ODSA.

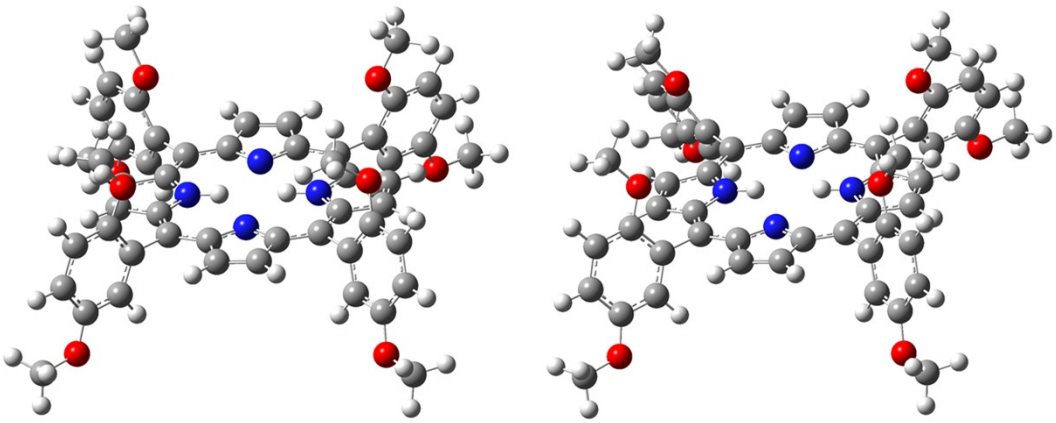


Figure S12. Calculated stable structures of a porphyrin derivative (left) and an electron-porphyrin complex (i.e., anion radical, right).