Chloro Aluminum Phthalocyanine-based Organic Thin-Film Transistors as Cannabinoid Sensors: Engineering the thin film response.

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Supporting Information

Table S1. Device characteristics of Cl-AlPc OTFTs with different device structures.

W/L[a]	Thickness[a] [nm]	I_{on}[b] [10^{-4} A]	$I_{on/off}$[b]	μ_h[b] [10^{-2} cm^2/Vs]	*H*[b] [V]	V_T[b] [V]
100	30	0.38 ± 0.04	10^4	2.3 ± 0.2	4.03 ± 0.002	-0.9 ± 0.8
	50	0.70 ± 0.07	10^4	3.3 ± 0.3	7.14 ± 0.004	10.7 ± 1.1
	100	0.82 ± 0.03	10^3	3.9 ± 0.1	10.42 ± 0.67	30.5 ± 1.1
200	30	1.0 ± 0.1	10^4	2.6 ± 0.1	6.72 ± 0.002	7.2 ± 0.7
	50	1.9 ± 0.2	10^4	4.1 ± 0.5	9.29 ± 0.82	13.0 ± 0.7
	100	2.1 ± 0.1	10^3	5.3 ± 0.5	11.09 ± 0.67	33.2 ± 0.7
400	30	1.8 ± 0.4	10^4	2.2 ± 0.4	8.74 ± 0.78	13.2 ± 0.7
	50	4.7 ± 0.7	10^4	5.2 ± 0.8	10.00 ± 0.10	15.7 ± 0.8
	100	6.2 ± 0.2	10^3	8.3 ± 0.4	11.09 ± 0.67	29.2 ± 0.7
800	30	3.3 ± 0.5	10^4	1.9 ± 0.3	9.41 ± 0.004	12.6 ± 1.3
	50	13 ± 2	10^4	6.9 ± 0.9	11.07 ± 0.71	20.0 ± 0.8
	100	14 ± 0.3	10^3	9.9 ± 0.2	13.11 ± 0.67	31.9 ± 0.7
1000	30	40 ± 0.8	10^5	43 ± 2	4.47 ± 0.93	-5.7 ± 1.5
	50	67 ± 2	10^5	71 ± 3	2.59 ± 0.50	-8.0 ± 0.8
	100	45 ± 4	10^5	57 ± 5	2.35 ± 0.55	-12.0 ± 0.8

[a] OTFTs with following structure Si (gate), 230 nm SiO_2 (dielectric), ITO adhesion layer with gold source drain electrodes with different width/length ratios and different thicknesses of Cl-AlPc (semiconductor).
[b] On current (I_{on}), on and off current ratio ($I_{on/off}$), hole mobility (μ_h), hysteresis (*H*), and threshold voltage (V_T). All values were averaged from a minimum of four devices.

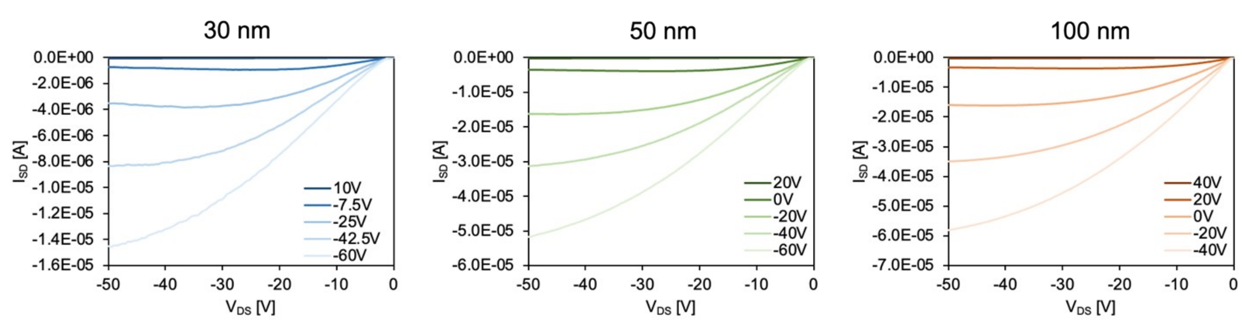

Figure S1. Characteristic output curves (A, B, C) were taken for the OTFTs with *W/L* = 200 for comparison. Cl-AlPc film thickness was varied from 30 nm (A), 50 nm (B) and 100 nm (C).

Table S2. Two-way ANOVA analysis of pair-wise comparisons of *W/L* and thickness for baseline device I_{on} and μ_h using a 95% confidence interval ($\alpha = 0.05$). Significant interactions are shown in green, and non-significant interactions are shown in red.

Baseline I_{on}

***W/L* Constant**	30 nm → 50 nm	30 nm → 100 nm	50 nm → 100 nm
W/L = 100	*	n.s.	*
W/L = 200	*	n.s.	*
W/L = 400	*	n.s.	*
W/L = 800	*	n.s.	*
W/L = 1000	*	n.s.	*
Thickness Constant	30 nm	50 nm	100 nm
100 → 200	n.s.	n.s.	n.s.
100 → 400	n.s.	n.s.	n.s.
100 → 800	*	*	*
100 → 1000	*	*	*
200 → 400	n.s.	n.s.	n.s.
200 → 800	n.s.	n.s.	n.s.
200 → 1000	*	*	*
400 → 800	n.s.	n.s.	n.s.
400 → 1000	*	*	*
800 → 1000	*	*	*

Baseline μ_h

***W/L* Constant**	30 nm → 50 nm	30 nm → 100 nm	50 nm → 100 nm
W/L = 100	*	*	n.s.
W/L = 200	*	*	n.s.
W/L = 400	*	*	n.s.
W/L = 800	*	*	n.s.
W/L = 1000	*	*	n.s.
Thickness Constant	30 nm	50 nm	100 nm
100 → 200	n.s.	n.s.	n.s.
100 → 400	n.s.	n.s.	n.s.
100 → 800	n.s.	n.s.	n.s.
100 → 1000	*	*	*
200 → 400	n.s.	n.s.	n.s.
200 → 800	n.s.	n.s.	n.s.
200 → 1000	*	*	*
400 → 800	n.s.	n.s.	n.s.
400 → 1000	*	*	*
800 → 1000	*	*	*

* = $p < 0.05$, significant

n.s. = not significant

Table S3. Contact resistance (R_C) and width-normalized contact resistance (R_CW) for OTFTs with Cl-AlPc film thickness of 30 nm, 50 nm, and 100 nm.

	30 nm	**50 nm**	**100 nm**
R_C [Ω]	43 244 000	3 750 000	1 420 400
R_CW [Ω cm]	865 000	75 000	28 400

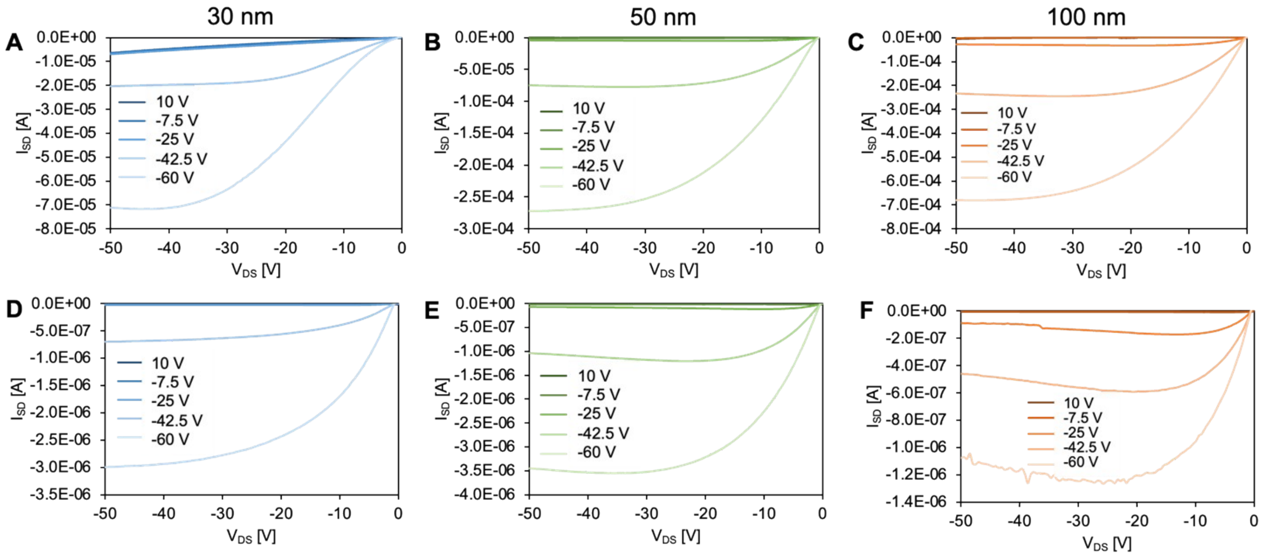

Figure S2. Output curves for Cl-AlPc BGBC OTFT THC sensors exposed to a THC solution (A, B, C) and to THC vapor (D, E, F). Cl-AlPc film thickness was varied from 30 nm (A, D), 50 nm (B, E) and 100 nm (C, F). As a comparison all output curves are for devices with $W/L = 200$.

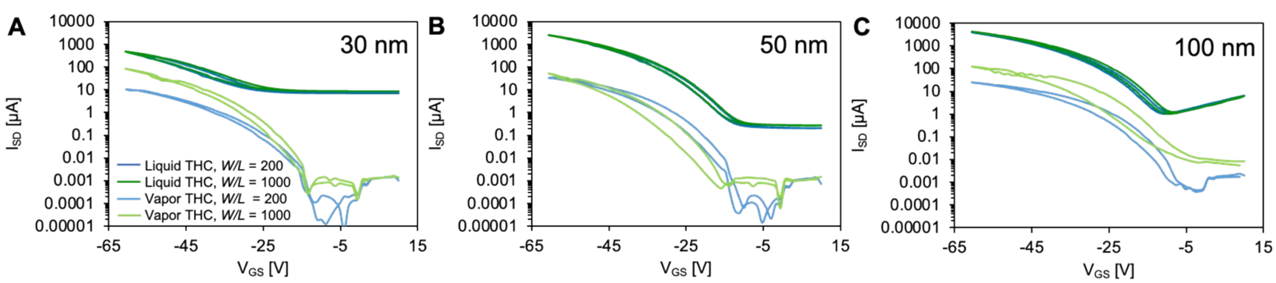

Figure S3. Transfer curves for Cl-AlPc BGBC OTFT THC sensors for different W/L between 200 and 1000. Cl-AlPc film thickness was varied from 30 nm (A), 50 nm (B) and 100 nm (C).

Table S4. Two-way ANOVA results of pair-wise comparisons of W/L and thickness for liquid THC and vapor THC-exposed devices for V_T, $I_{on/off}$, and μ_h using a 95% confidence interval (α = 0.05). Significant interactions are shown in green, and non-significant interactions are shown in red.

V_T – Liquid THC

***W/L* Constant**	30 nm → 50 nm	30 nm → 100 nm	50 nm → 100 nm
W/L = 200	*	*	n.s.
W/L = 1000	*	*	n.s.
Thickness Constant	30 nm	50 nm	100 nm
200 → 1000	n.s.	n.s.	n.s.

V_T – Vapor THC

W/L Constant	30 nm → 50 nm	30 nm → 100 nm	50 nm → 100 nm
W/L = 200	*	*	*
W/L = 1000	*	*	*
Thickness Constant	30 nm	50 nm	100 nm
200 → 1000	*	*	*

$I_{on/off}$ – Liquid THC

***W/L* Constant**	30 nm → 50 nm	30 nm → 100 nm	50 nm → 100 nm
W/L = 200	*	*	n.s.
W/L = 1000	*	*	n.s.
Thickness Constant	30 nm	50 nm	100 nm
200 → 1000	*	*	*

$I_{on/off}$ – Vapor THC

***W/L* Constant**	30 nm → 50 nm	30 nm → 100 nm	50 nm → 100 nm
W/L = 200	n.s.	*	*
W/L = 1000	n.s.	*	*
Thickness Constant	30 nm	50 nm	100 nm
200 → 1000	*	*	*

Mobility – Liquid THC

***W/L* Constant**	30 nm → 50 nm	30 nm → 100 nm	50 nm → 100 nm
W/L = 200	*	*	n.s.
W/L = 1000	*	*	n.s.
Thickness Constant	30 nm	50 nm	100 nm
200 → 1000	n.s.	n.s.	n.s.

Mobility – Vapor THC

***W/L* Constant**	30 nm → 50 nm	30 nm → 100 nm	50 nm → 100 nm
W/L = 200	n.s.	*	*
W/L = 1000	n.s.	*	*
Thickness Constant	30 nm	50 nm	100 nm
200 → 1000	*	*	*

* = $p < 0.05$, significant
n.s. = not significant

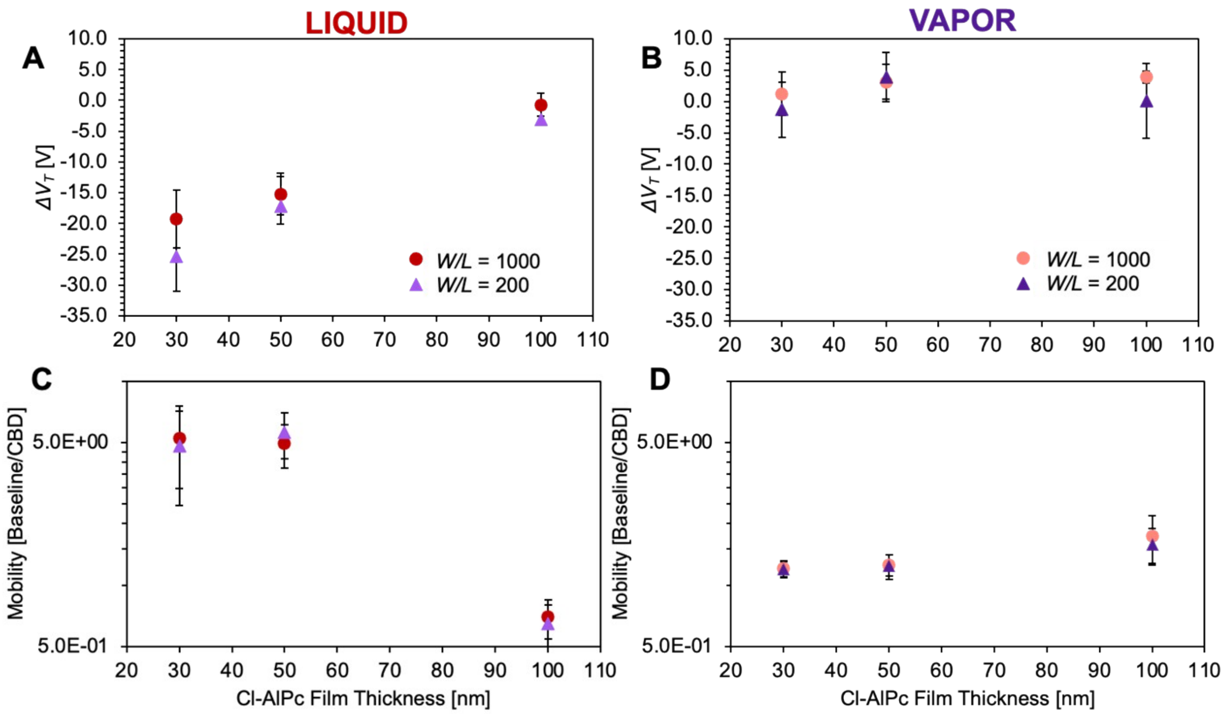

Figure S4. Cl-AlPc OTFT based sensor characteristics when exposed to CBD solution (A, C), and CBD vapor (B, D). The device performance changes are reported different from the baseline device and the exposed device for V_T (A, B), and a ratio from the baseline and the exposed device for mobility (C, D). Points represent the means of a minimum of 4 devices and error bars represent standard deviation.

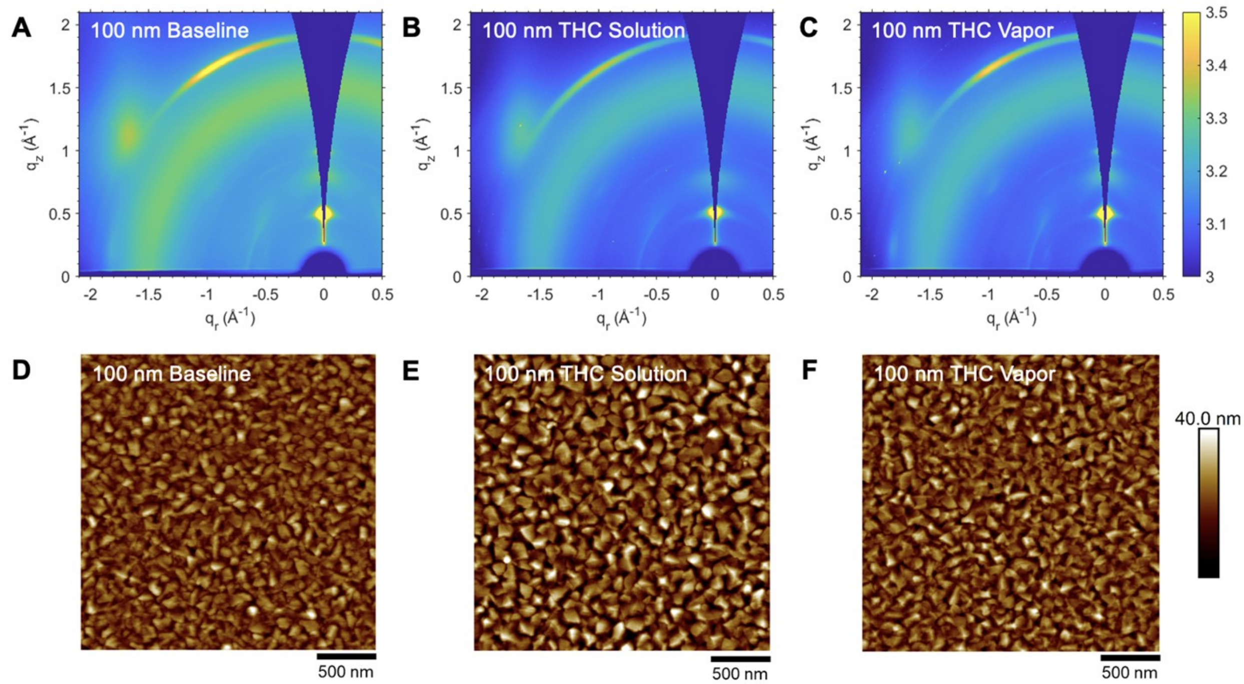

Figure S5. 2D scattering patterns (θ = 0.3°) of (A) unexposed baseline, (B) THC solution exposed, and (C) THC vapor exposed 100 nm thick Cl-AlPc. AFM images of (D) unexposed baseline (RMS = 5.06 nm), (E) THC solution exposed (RMS = 7.58 nm), and (F) THC vapor exposed (RMS = 5.26 nm) 100 nm thick Cl-AlPc with scale bars of 500 nm.

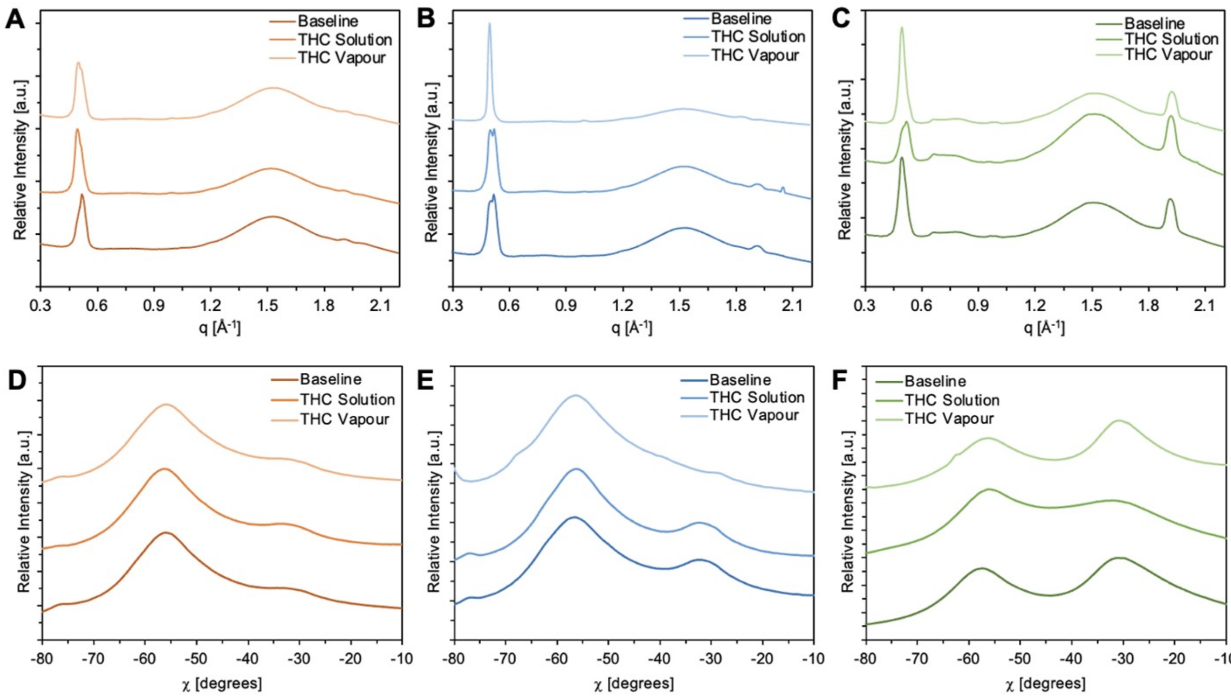

Figure S6. Diffraction patterns (A, B, C) and linecut profiles with respect to χ between a q of 1.9-2.1 Å^{-1} (D, E, F) of 30 nm (A, D), 50 nm (B, E) and 100 nm (C, F) thick Cl-AlPc exposed to THC solution and vapor.