Electronic Supplementary Material (ESI) for Materials Advances.

Supporting information

Effects of alumina priming on electrical properties of ZnO nanostructures derived from vapor-phase infiltration into self-assembled block copolymer thin films†

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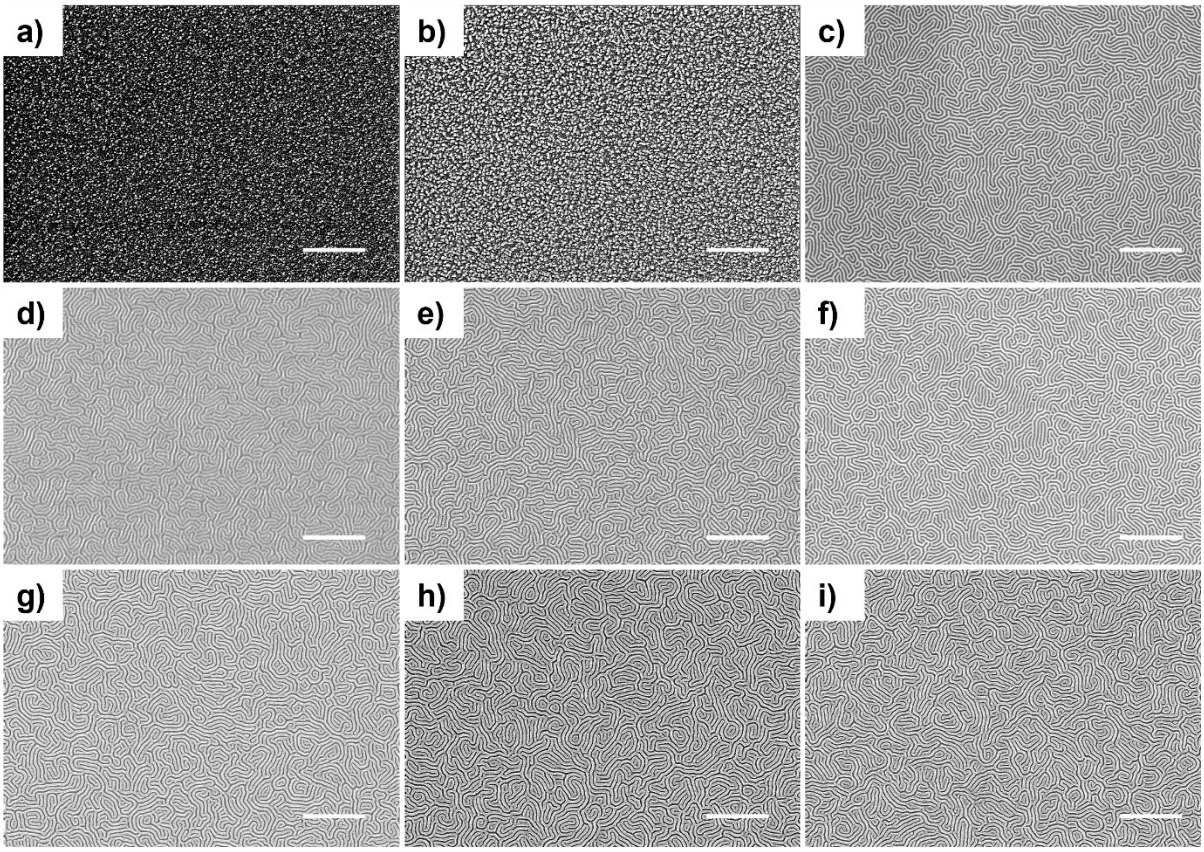

Fig. S1. Top-view SEM micrographs of AZO fingerprint patterns synthesized by VPI with different TMA exposure times, (a) 0 s, (b) 10 s, (c) 25 s, (d) 50 s, (e) 75 s, (f) 100 s, (g) 200 s, (h) 400 s, and (i) 800 s. All scale bars denote 1 μm.

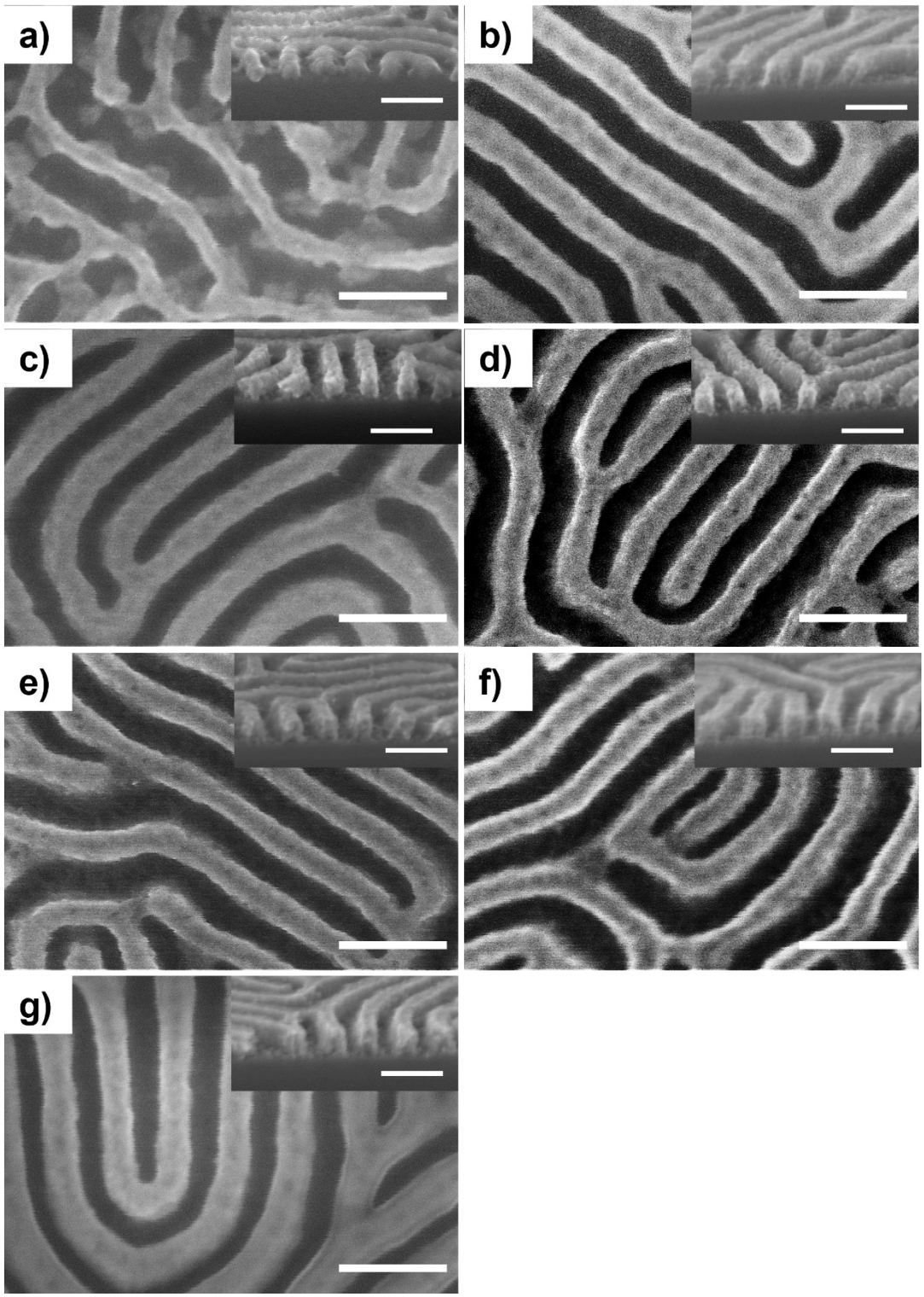

Fig. S2. Top-view of high magnification SEM micrographs of AZO fingerprint patterns synthesized by VPI with different TMA exposure time, (a) 25 s, (b) 50 s, (c) 75 s, (d) 100 s, (e) 200 s, (f) 400 s, and (g) 800 s. Insets depict cross-sectional SEM micrographs. All scale bars denote 100 nm.

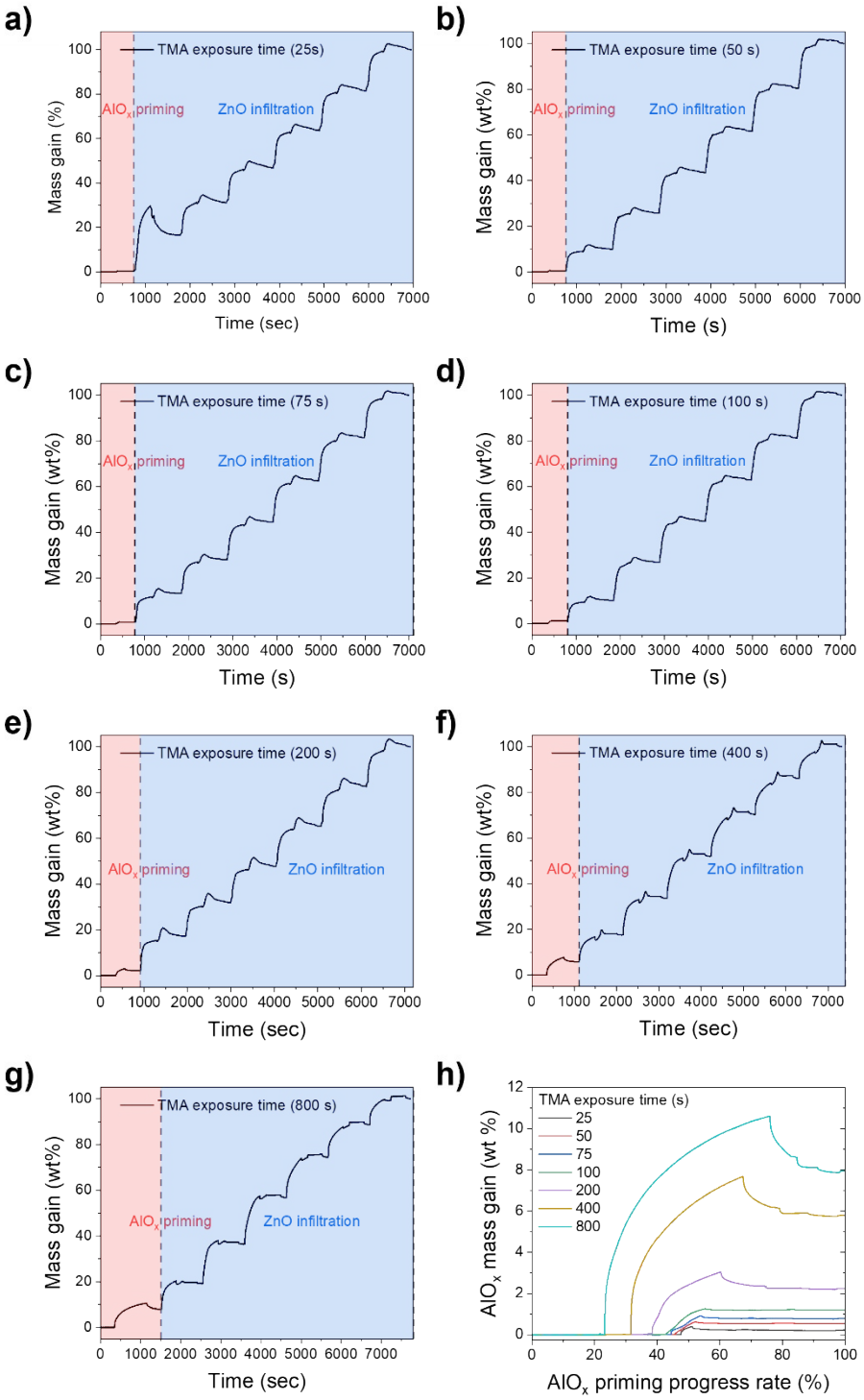

Fig. S3. Mass gain profile using in situ QCM during alumina primed zinc oxide VPI into PS-*b*-PMMA for varying TMA exposure duration; a) 25 s, b) 50 s, c) 75 s, d) 100 s, e) 200 s, f) 400 s, g) 800 s, and h) AlO_x mass gain profiles during different AlO_x priming cycles.

Table S1. Element composition of AZO structures for different TMA exposure time estimated using energy dispersive X-ray spectroscopy (EDS) analysis.

TMA exposure time (s)	Oxygen (at. %)	Silicon (at. %)	Aluminum (at. %)	Zinc (at. %)	Al/(Al+Zn) (%)	Zn/Al ratio
25	8.92 ± 0.13	84.64 ± 0.16	0.21 ± 0.02	6.23 ± 0.07	3.30	29.29
50	11.52 ± 0.09	79.09 ± 0.19	0.35 ± 0.02	9.03 ± 0.10	3.77	25.55
75	13.33 ± 0.08	75.47 ± 0.14	0.52 ± 0.04	10.69 ± 0.10	4.64	20.55
100	13.66 ± 0.21	73.87 ± 0.32	0.75 ± 0	11.71 ± 0.12	6.02	15.62
200	14.28 ± 0.33	72.38 ± 0.49	1.23 ± 0.07	12.11 ± 0.13	9.22	9.84
400	16.63 ± 0.71	68.80 ± 1.00	1.77 ± 0.07	12.80 ± 0.21	12.15	7.23
800	14.61 ± 0.05	71.56 ± 0.11	1.87 ± 0.03	11.98 ± 0.13	13.48	6.42

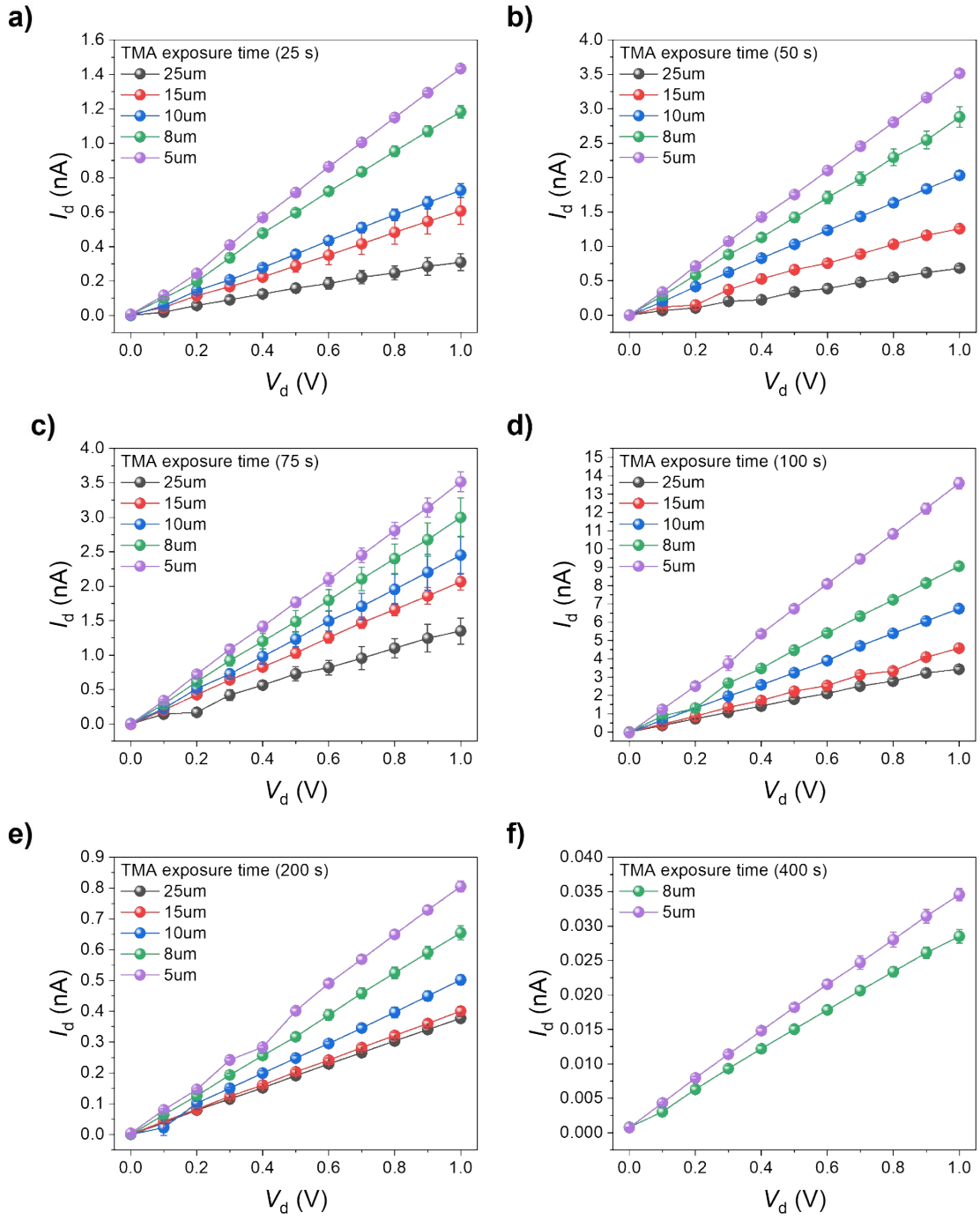

Fig. S4. I-V plots of TLM structure devices with various channel lengths (5, 8, 10, 15, 25 μm) of AZO nanopatterns with varying TMA exposure time; a) 25 s, b) 50 s, c) 75 s, d) 100 s, e) 200 s, and f) 400 s).

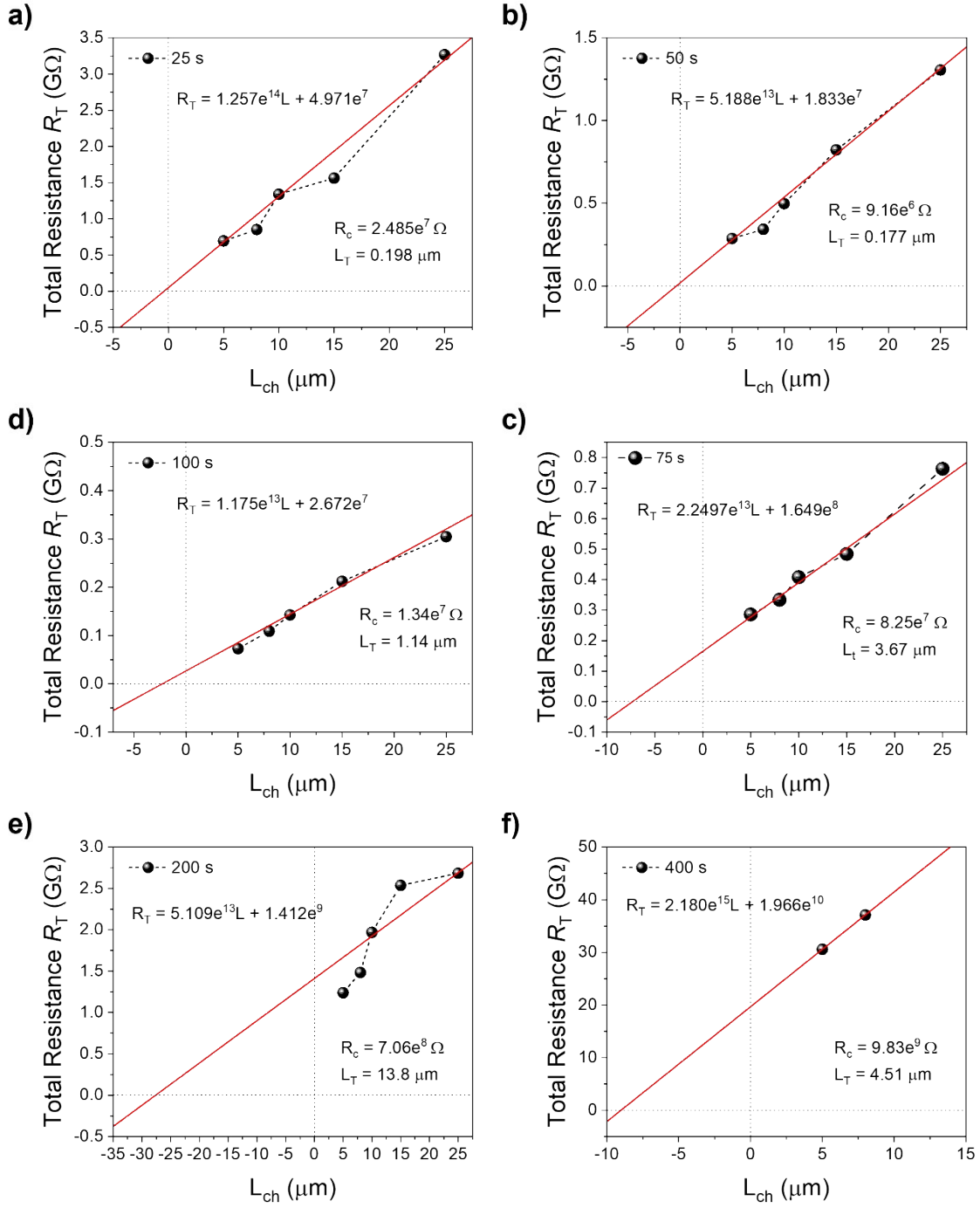

Fig. S5. Plots of total resistance (R_T) vs. channel length of AZO nanostructure contacted TLM structures with different TMA exposure time; a) 25 s, b) 50 s, c) 75 s, d) 100 s, e) 200 s, and f) 400 s).

Table S2. Summary of reported resistivity of AZO materials according to structure.

AZO structure	Resistivity (Ω·cm)	Al contents (%)	Optimal Al doping content (%)	Reference
Thin film (200 nm)	$1.36 – 20 \times 10^{-3}$	1.67 – 10	5	1
Thin film (100 nm)	$8 – 12 \times 10^{-3}$	0 – 12	4.2	2
Thin film (90 nm)	$0.6 – 10 \times 10^{-3}$	1.2 – 5.19	3.41	3
Thin film (50 nm)	$0.75 – 1.6 \times 10^{3}$	1 – 9	5	4
Nanoparticle (57 – 106 nm)	4 – 6.66	0 – 6	6	5
Nanoparticle (12 – 34 nm)	$1 – 50 \times 10^{7}$	0 – 6	4	6

References –

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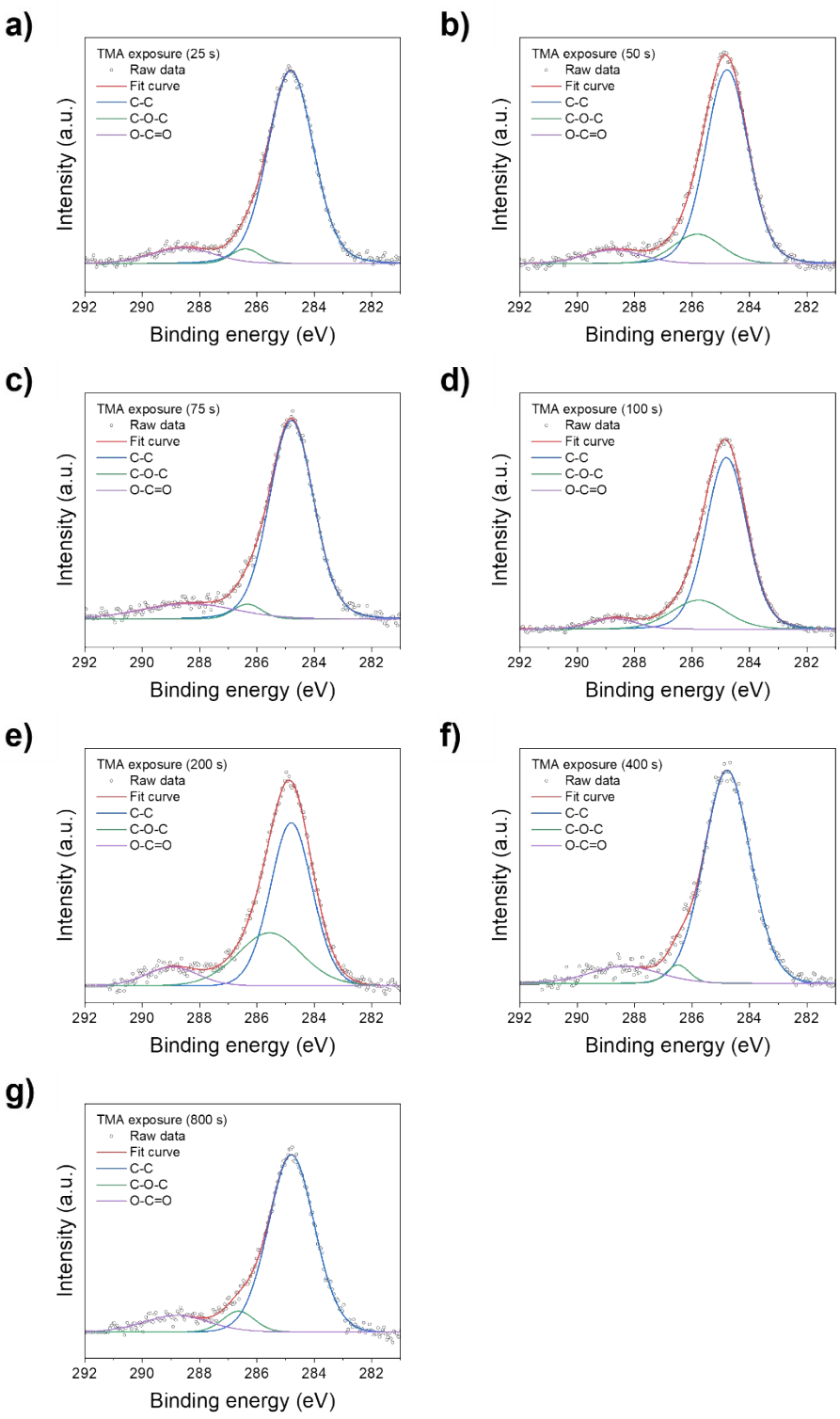

Fig. S6. High resolution XPS spectra of C 1s for AZO nanostructure with different TMA exposure time; a) 25 s, b) 50 s, c) 75 s, d) 100 s, e) 200 s, f) 400 s, and g) 800 s.

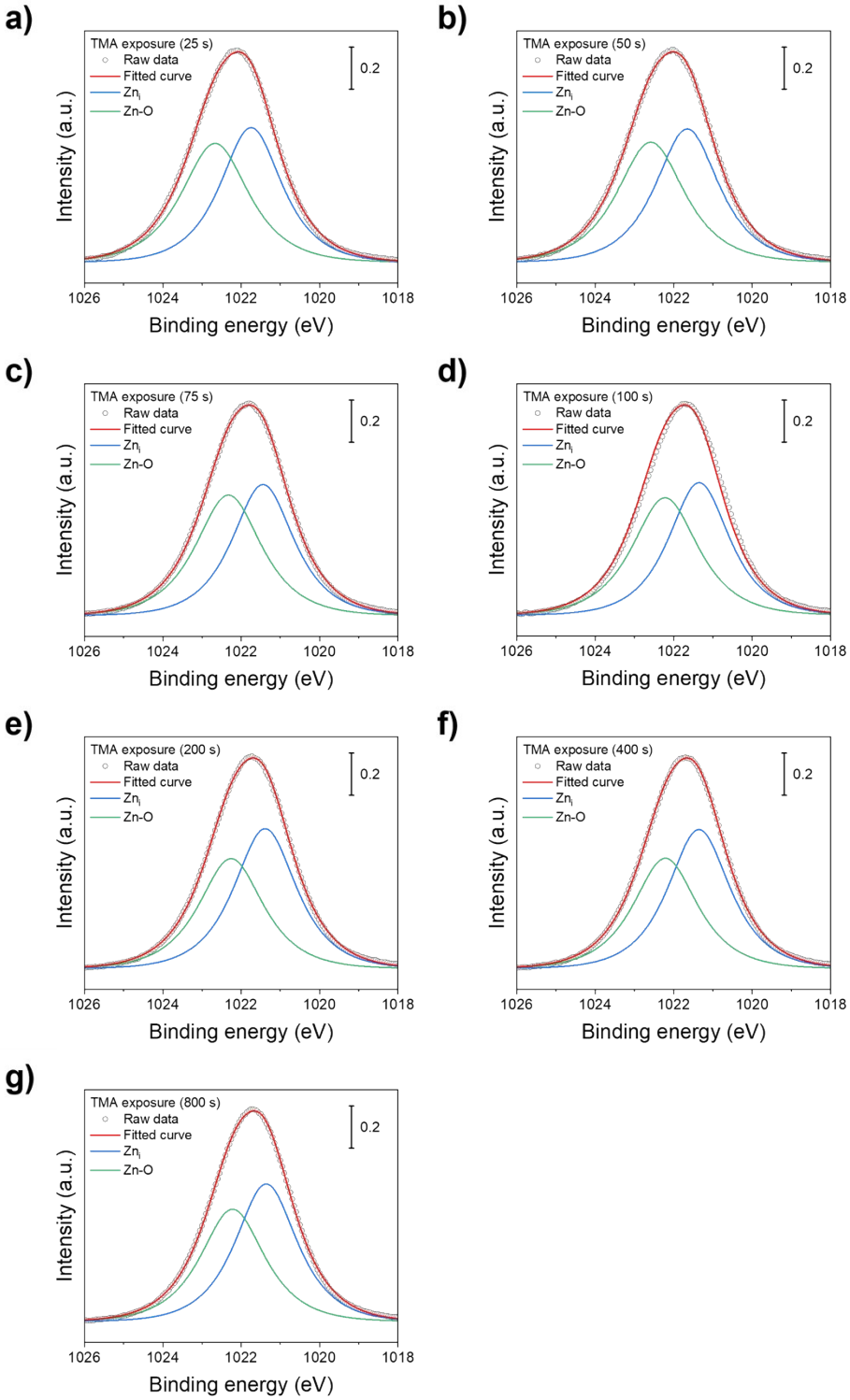

Fig. S7. High resolution XPS spectra of Zn 2p for AZO nanostructure with different TMA exposure time; a) 25 s, b) 50 s, c) 75 s, d) 100 s, e) 200 s, f) 400 s, and g) 800 s.

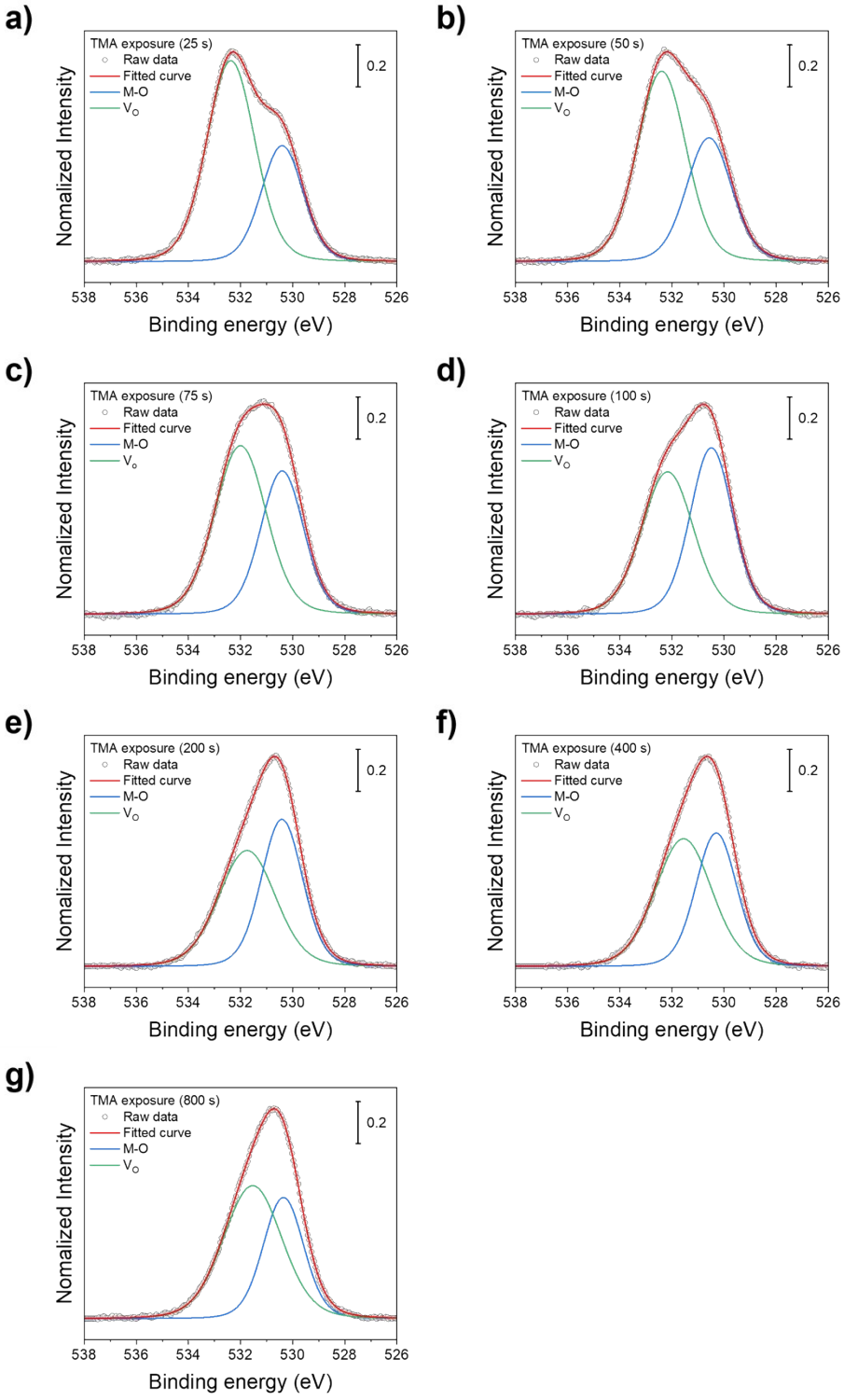

Fig. S8. High resolution XPS spectra of O 1s for AZO nanostructure with different TMA exposure time; a) 25 s, b) 50 s, c) 75 s, d) 100 s, e) 200 s, f) 400 s, and g) 800 s.

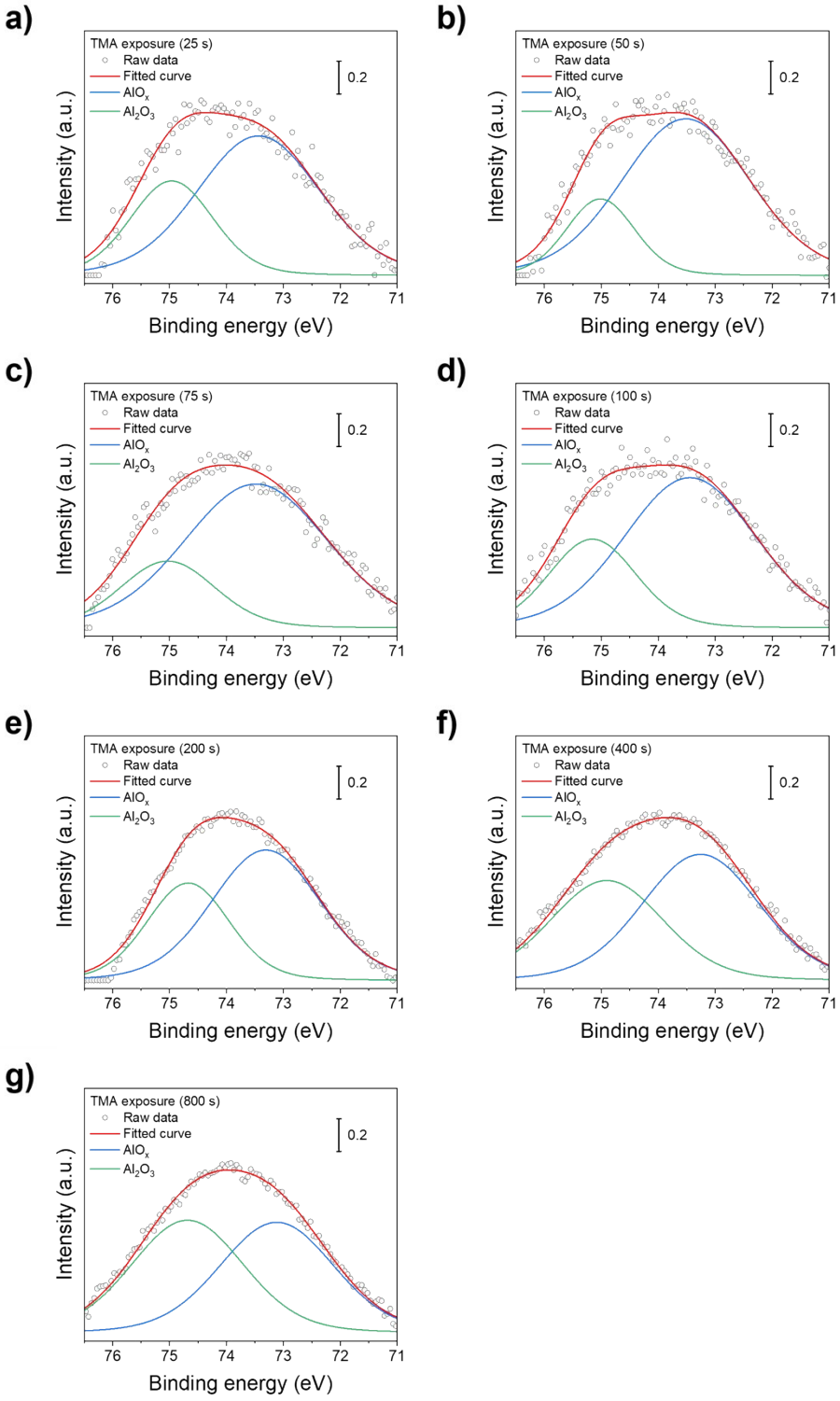

Fig. S9. High resolution XPS spectra of Al 2p for AZO nanostructure with different TMA exposure time; a) 25 s, b) 50 s, c) 75 s, d) 100 s, e) 200 s, f) 400 s, and g) 800 s.