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

Soluble oxide gate dielectrics prepared using the self-combustion reaction for high-performance thin-film transistors

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Additional Figures

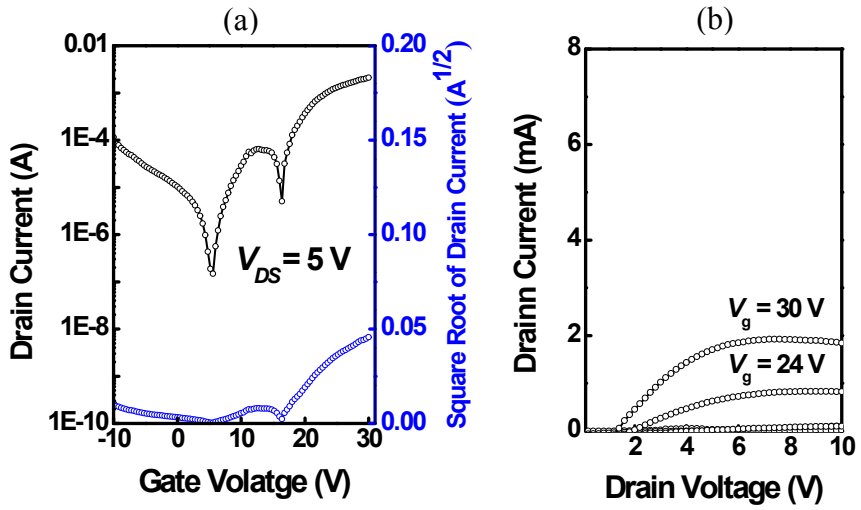

Fig. S1 (a) The transfer and (b) output characteristics of ZnO TFT fabricated from non-combustive AlO_x gate dielectric with $Al(C_2H_5O_2)_3$ precursor with GPTMS.

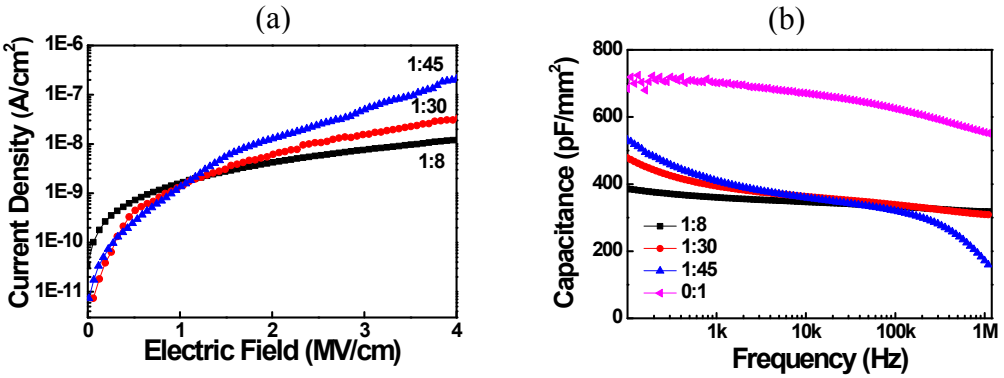

Fig. S2 (a) Current density vs. electrical field and (b) dependence of capacitance on the frequency for self-combustive AlO_x thin films with various amounts of GPTMS.

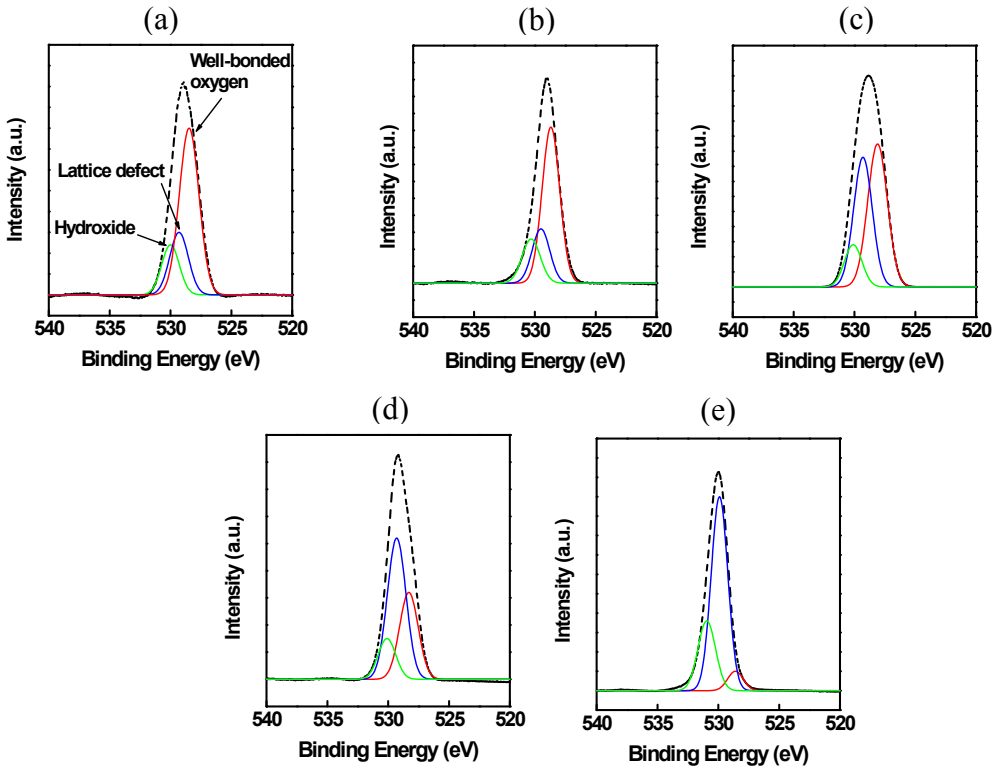

Fig. S3 XPS spectra of AlO_x thin films prepared from various precursors: (a) self-combustive AlO_x precursor, (b) self-combustive AlO_x precursor with GPTMS, (c) combustive precursor with urea, (d) noncombustive $Al(NO_3)_3 \cdot 9H_2O$, and (e) noncombustive $Al(C_2H_5O_2)_3$.

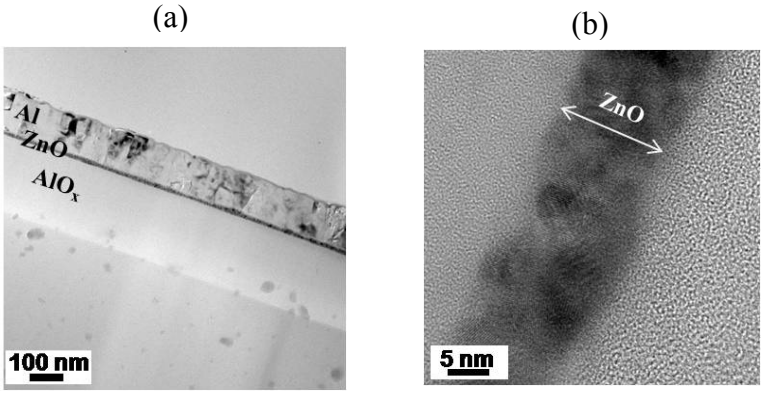

Fig. S4 TEM cross sectional images of the ZnO TFT with self-combustive AlO_x gate dielectric: (a) cross sectional TEM image of ZnO TFT and (b) cross sectional TEM image of magnified ZnO layer between AlO_x gate dielectric and Al electrode.

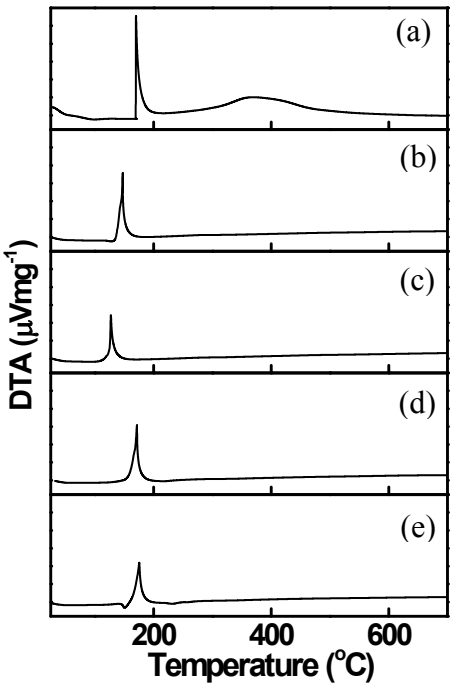

Fig. S5 TG-DTA curves of combustive AlO_x precursors with different ratios of $Al(C_2H_5O_2)_3$ to $Al(NO_3)_3 \cdot 9H_2O$: (a) $Al(C_2H_5O_2)_3/Al(NO_3)_3 \cdot 9H_2O$ = 1/1, (b) $Al(C_2H_5O_2)_3/Al(NO_3)_3 \cdot 9H_2O$ = 1/2, (c) $Al(C_2H_5O_2)_3/Al(NO_3)_3 \cdot 9H_2O$ = 1/3, (d) $Al(C_2H_5O_2)_3/Al(NO_3)_3 \cdot 9H_2O$ = 2/1, and (e) $Al(C_2H_5O_2)_3/Al(NO_3)_3 \cdot 9H_2O$ = 3/1.

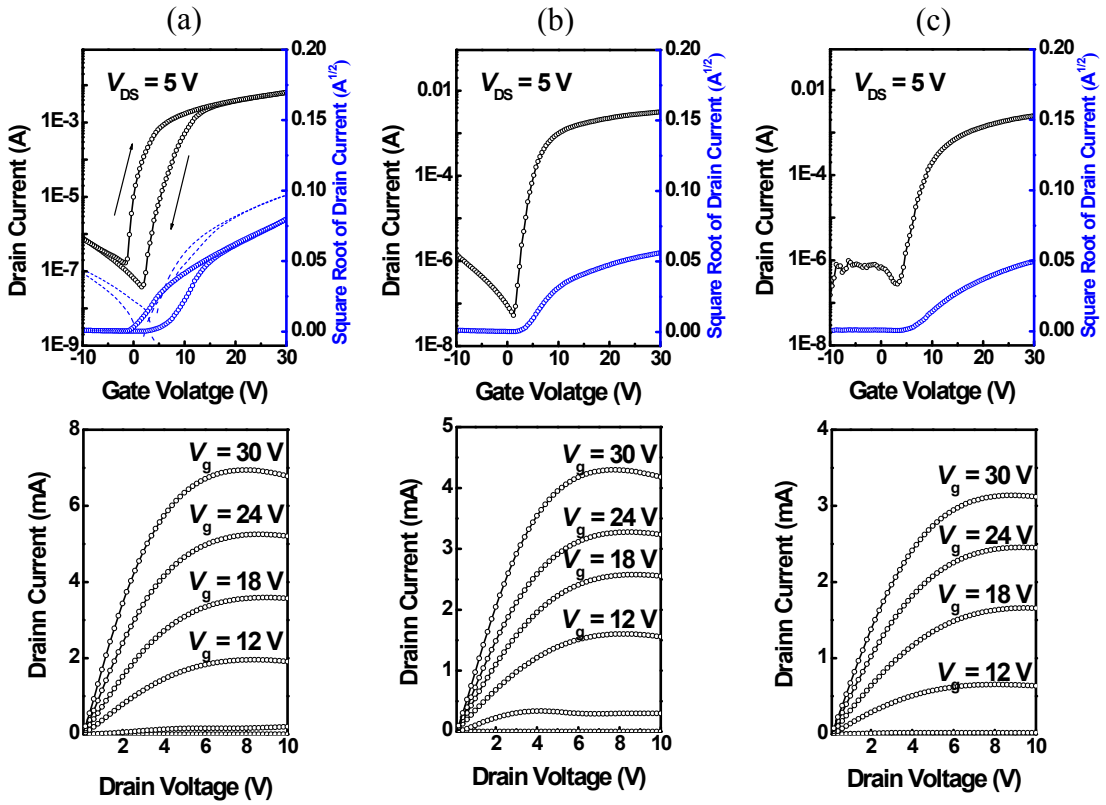

Fig. S6 Transfer and output characteristics of the ZnO TFTs fabricated from AlO_x gate dielectrics with 1:8 ratios of the self-combustive AlO_x precursor to GPTMS depending on different composition ratios of $Al(C_2H_5O_2)_3$ to $Al(NO_3)_3{\cdot}9H_2O$: (a) $Al(C_2H_5O_2)_3/Al(NO_3)_3{\cdot}9H_2O$ = 1/1, (b) $Al(C_2H_5O_2)_3/Al(NO_3)_3{\cdot}9H_2O$ = 1/3, (c) $Al(C_2H_5O_2)_3/Al(NO_3)_3{\cdot}9H_2O$ = 3/1.

Table S1 Characteristics of ZnO TFTs fabricated from AlO_x gate dielectrics with 1:8 ratios of the self-combustive AlO_x precursor to GPTMS depending on different composition ratios of $Al(C_2H_5O_2)_3$: $Al(NO_3)_3 \cdot 9H_2O$

molar ratio ($Al(C_2H_5O_2)_3$: $Al(NO_3)_3 \cdot 9H_2O$)	mobility [a] ($cm^2\ V^{-1}\ s^{-1}$)	threshold voltage (V)	on/off ratio
1:1	24.7	6.35	1.71E + 05
1:3	20.6	3.04	6.00E + 04
3:1	6.56	5.61	1.610E + 04

[a]Calculated from capacitance values extrapolated to a frequency of 1 Hz

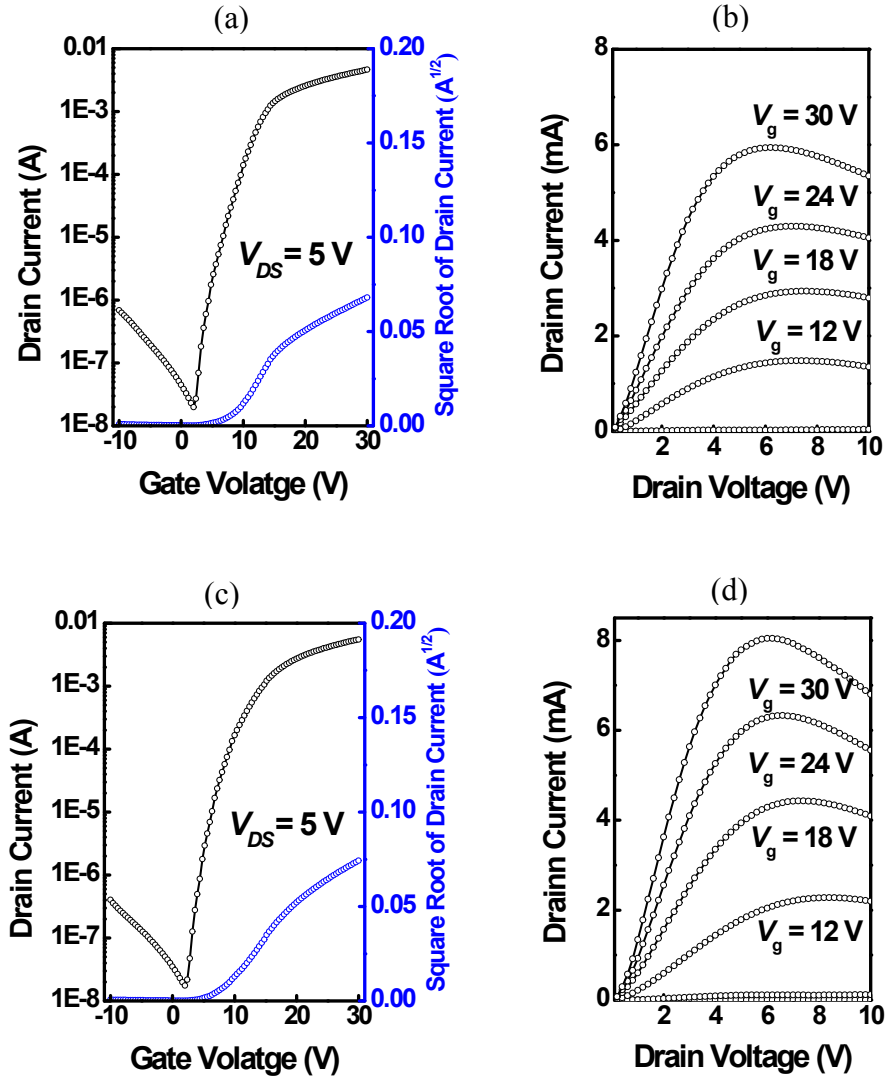

Fig. S7 (a) Transfer and (b) output characteristics of the ZnO TFTs fabricated from AlO_x gate dielectrics with 1:30 ratios of the self-combustive AlO_x precursor to GPTMS. (c) Transfer and (d) output characteristics of the ZnO TFTs fabricated from AlO_x gate dielectrics with 1:45 ratios of the self-combustive AlO_x precursor to GPTMS.

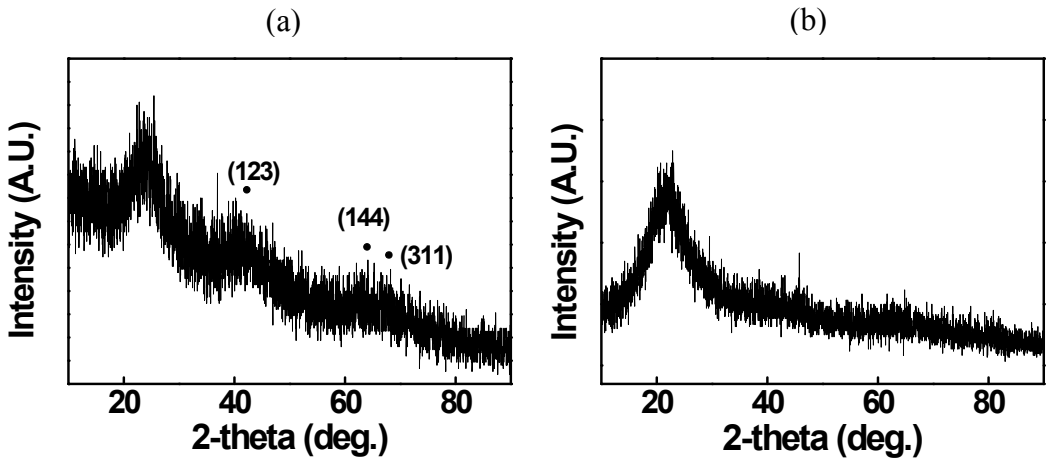

Fig. S8 XRD pattern of the (a) self-combustive and (b) non-combustive AlO_x films deposited on the glass substrate after annealing at 250℃.