## **Electronic Supplementary Information**

## CrystEngComm

"Low-Temperature Crystal Growth of Aluminium-Doped Zinc Oxide Nanoparticles in a Melted Viscous Liquid of Alkylammonium Nitrates for Fabrication of Their Transparent Crystal Films"

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Fig. S1 FT-IR spectrum of the isolated AZO nanoparticles.



Fig. S2 TG profile of the isolated AZO nanoparticles.



**Fig. S3** Mass spectra of the isolated AZO nanoparticles adsorbing surface-protecting molecules (a) and isopropylamine from the database (b).



**Fig. S4** The three-step heating program (a) and the corresponding TG profile (b) of the precursor dispersion solution of 2% AZO nanoparticles.

## Synthesis of isopropylammonium nitrate

A methanol solution (50 mL) of isopropylamine (5.91 g, 0.100 mol) was dropped to 60% HNO<sub>3</sub> (9.00 g), heated at 60°C for 15 min, and cooled to room temperature. Needle-shaped crystals of isopropylammonium nitrate (( $C_3H_7NH_3$ )NO<sub>3</sub>) were separated from the solution by filtration, washed with methanol and dried under air.



Fig. S5 TG-DTA profile of the synthesised isopropylammonium nitrate.



**Fig. S6** Cross-section SEM images of the fabricated AZO films using various volumes of the precursor dispersion solutions; 100 (a), 200 (b), 400 (c), 600 (d), 800 (e), and 1000  $\mu$ L (f).



**Fig. S7** Hall resistivity of the 2% AZO films before (a) and after (b) post-annealing in a stream of a mixed gas of  $N_2$  and  $H_2$  ( $N_2/H_2 = 96 : 4 \text{ v/v}$ ) at 450°C. The Hall resistivity was measured under He at 300 K.

**Table S1**.  $R_H$ , n,  $\rho$ , and  $\mu$  of 2% AZO films before and after post-annealing in a stream of a mixed gas of N<sub>2</sub> and H<sub>2</sub> (N<sub>2</sub>/H<sub>2</sub> = 96 : 4 v/v) at 450°C\*

	$R_H / { m cm}^3{ m C}^{-1}$	<i>n</i> / cm <sup>-3</sup>	$ ho/\Omega$ cm	$\mu$ / cm <sup>2</sup> V <sup>-1</sup> s <sup>-1</sup>
Before post-annealing	-25.365	$2.30  imes 10^{18}$	3.4 × 10	$7.88 \times 10^{-2}$
After post-annealing	-2.095	$2.97  imes 10^{19}$	4.3 × 10 <sup>-2</sup>	4.85

\*Electron density, *n*, and mobility,  $\mu$ , of AZO films before and after post-annealing were calculated using the equations as described below (Table S1):

$n=1 / R_{H}e$	(1)
$\mu = 1 / ne\rho$	(2)

 $R_H$ , *e*, and  $\rho$  are the Hall coefficient, electrical charge, and measured resistivity of AZO films, respectively.  $R_H$  was calculated from the slope of Fig. S7.



**Fig. S8** Plot of the Al doping ratio versus the sheet resistance of AZO films heated in a stream of a mixed gas of  $N_2$  and  $H_2$  ( $N_2/H_2 = 96 : 4 \text{ v/v}$ ) at 450°C.