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

Supplementary Information

Supplementary methods

Thermogravimetric/differential thermal analysis (TG/DTA)

ITO solution was analyzed by using SII model TG/DTA 6200. **Fig. S1** shows the measurement result. Total time for the analysis was 180 minutes (heating rate 3.3 K/min). In the beginning, mass loss and heat absorption accompanying the evaporation of the solvent can be observed. The evaporation of the solvent completes at approximately 100 °C. This temperature is set as T_e. This is the point at which semisolid substances are formed. If the temperature is further increased, an exothermic reaction that possesses a steep peak starts at 225 °C and finishes near 330 °C. This exothermic peak corresponds to the solidification of semisolid substances. The starting point of the exothermic reaction is set as T_s (around 225 °C). Between T_e and T_s, the material is in a semi-solid state; thus, imprinting is performed between these temperatures.

IR Measurement

FTIR-8200 model produced by Shimazu Corporation, Japan, was used for IR measurement. Solid samples were prepared as follows. Drop casted ITO solutions on SiO_2 substrates were annealed at a desired temperature for 60 minutes. The annealing was carried out in air for the sample annealed less than 225°C while the annealing at 450°C was carried out in the atmosphere of N_2:O_2=8:2 by RTA (rapid thermal annealing) apparatus. The sample was removed from the substrate as powder and it was mixed with KBr powder and formed to a pellet by a pressing machine. The transmission FTIR measurement was carried out for the pellets in the range from 400 to 4000 cm^{-1}. Happ-Genzel function was used as an apodizing function. The signal from the KBr pellet was used as a background. **Fig. S2** shows their measurement results together with ITO solution, propionic acid (the solvent), In-$(acac)_3$ (the starting compound of In), and indium propionate.

T(r) calculation from In_2O_3 crystal

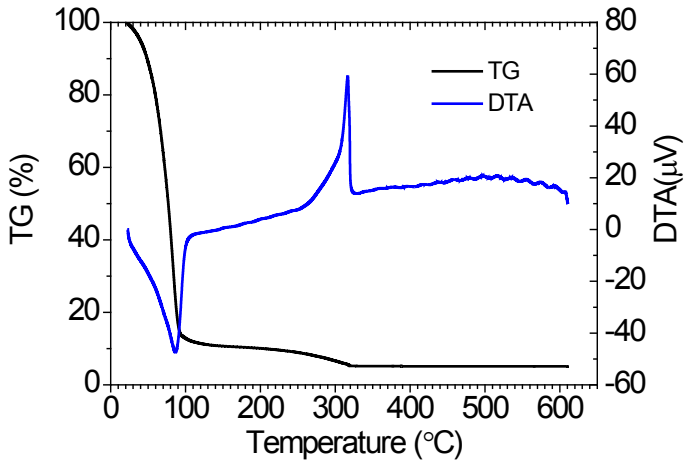
First, partial distributed functions *g(r)* were calculated by using the software of PDFFIT(PDFGUI) taking the atom coordination of the In_2O_3 crystal as the data. Then, each *g(r)* was weighted based on atom species, atomic ratio and coefficient of absorbance. After that, all *g(r)*s thus calculated were summed up to have the pair distribution function *G(r)* and then *T(r)*. The calculated *T(r)* is shown in **Fig. S4** compared with the measured *T(r)*s.

Thermal desorption spectrometry (TDS)

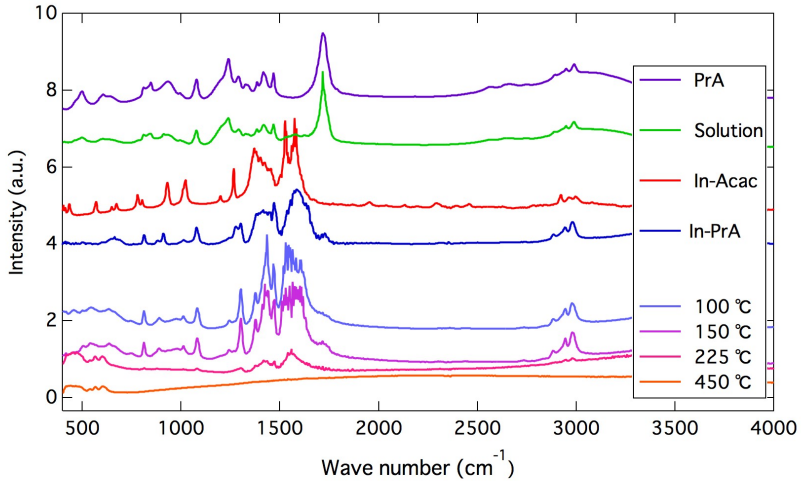
TDS is a mass spectrometry technique to measure gases that are desorbed from a sample during

heating in a vacuum. Gases are positively ionized by the collision of accelerated electrons and separated according to their mass-to-charge ratio. The rheology printed sample was cut to a size of 1 cm × 1 cm (only the part of the processed section). The sample for comparison (without imprinting) also had a section of the same size cut. **Fig. S5** shows the spectra of desorbed H_2O (M/z = 18), CO_2 (M/z = 44), CO or C_2H_4 (M/z = 28), and CH_4 (M/z = 16) gases again temperature. These gases cover at least 90% of the molecular volume of all desorbed gases. This analysis was done in MST (Foundation for Promotion of Material Science&Technology of Japan).

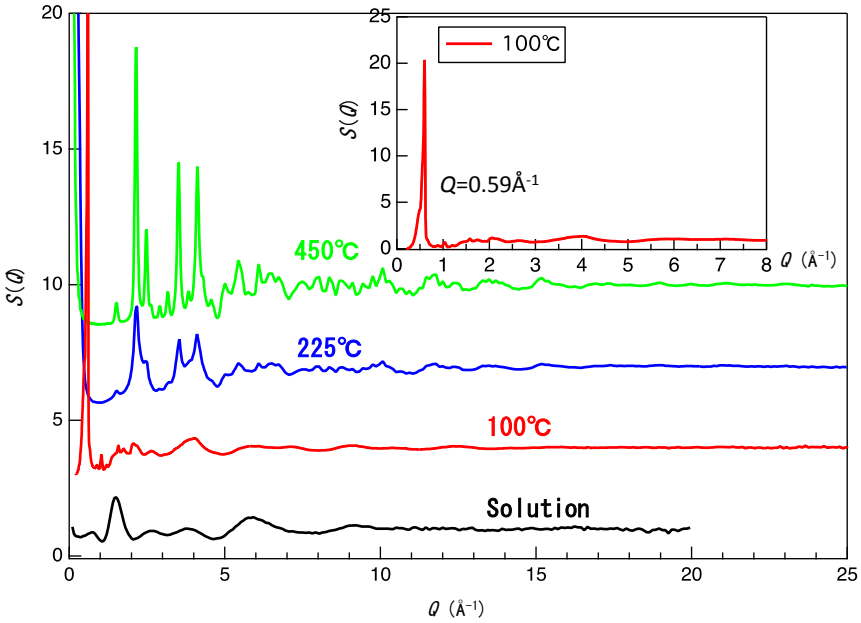
Supplementary Figures



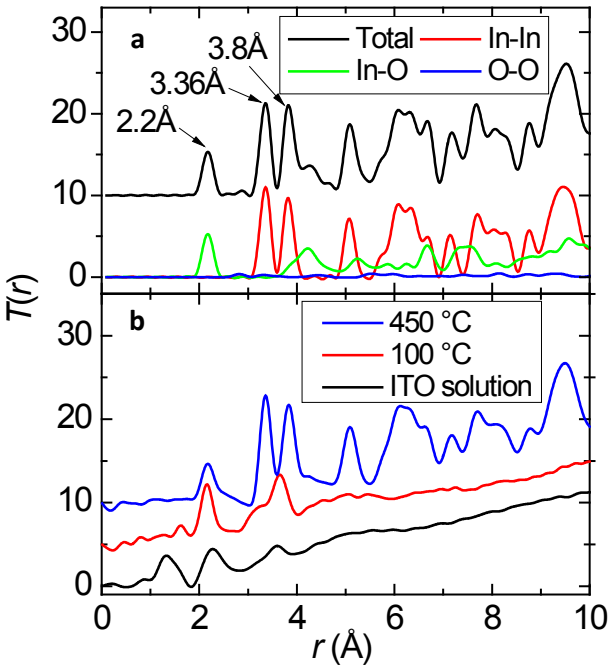
Supplementary Figure S1. Thermogravimetric/differential thermal analysis (TG/DTA) of the ITO solution.



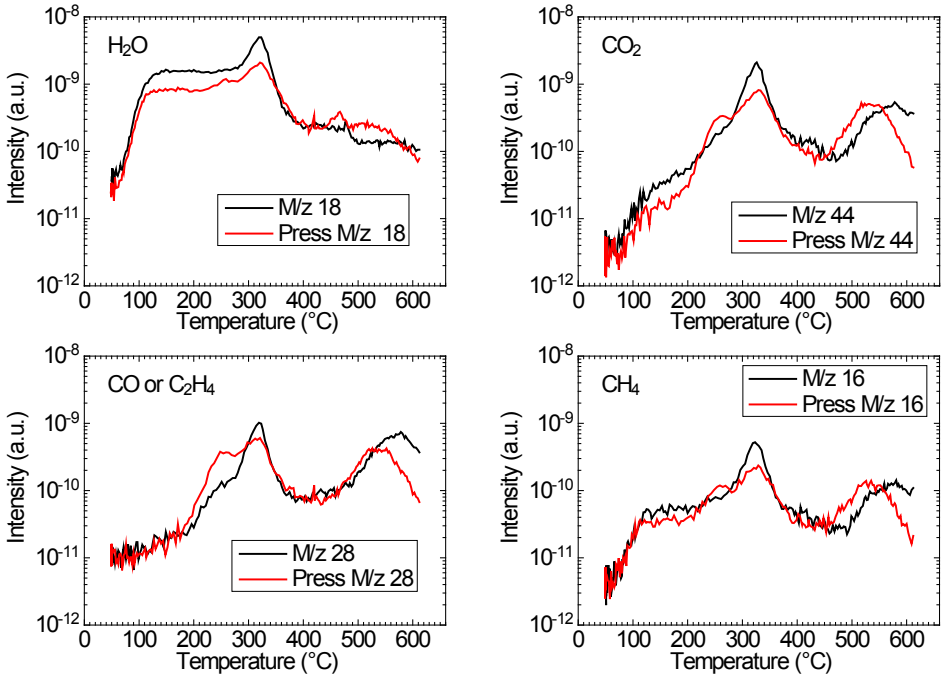
Supplementary Figure S2. IR spectra for the ITO solution, the solvent PrA, and starting compound of In (In-$(acac)_3$), and the ITO semi-solid and solid samples heated at the indicated temperatures for 60 min. Indium propionate was measured for reference.



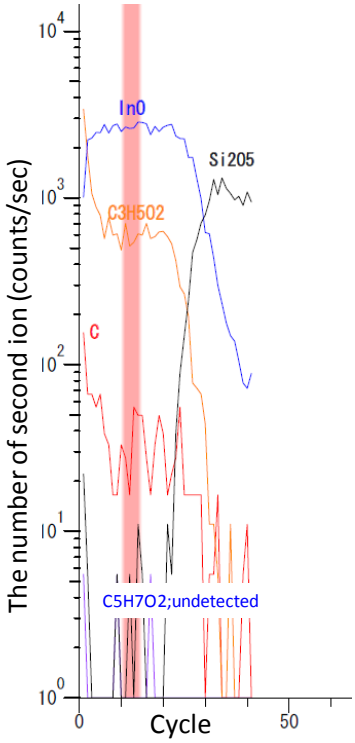
Supplementary Figure S3. The structure factors *S(Q)* changing with *Q* taken from 4 samples. The distinct peak which appeared at Q=0.59 Å^{-1} (d ~ 1.06 nm) in the 100°C-annealed sample is separately shown with expanded Q axis in the inset.



Supplementary Figure S4. Total correlation functions. **a**, Calculated for In_2O_3 crystal. **b**, Experimental data for the ITO solution and its derived semi-solid (100°C-dried) and solid (450°C-annealed).



Supplementary Figure S5. Temperature desorption spectroscopy analysis for an imprinted sample and one that underwent the same temperature profile as the imprinted sample but without applying press.



Supplementary Figure S6. An example of the spectra obtained in TOF-SIMS analysis.