Supplementary Information

Solution-Processed Inorganic Thin Film Transistors Fabricated from Butylamine-Capped Indium-Doped Zinc Oxide Nanocrystals

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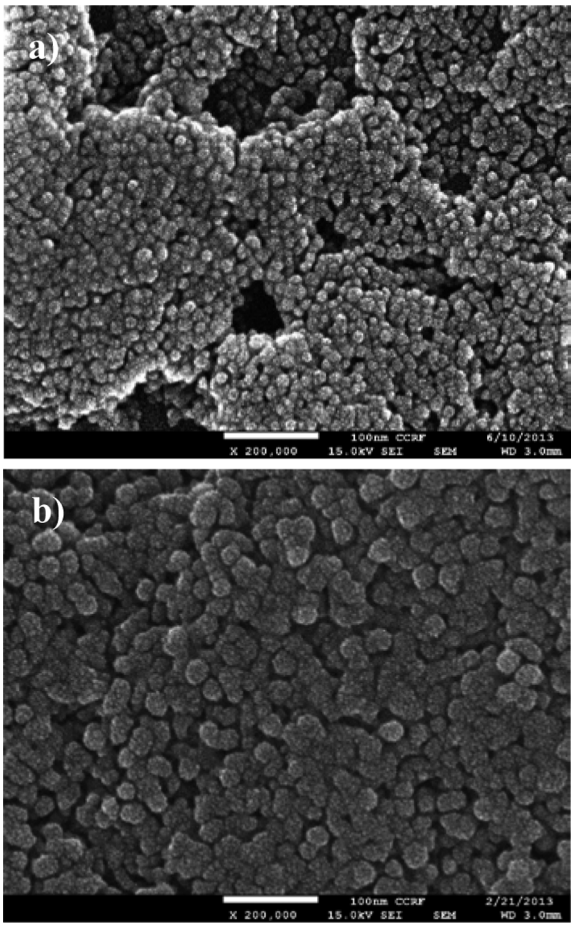

Figure S1. FE-SEM picture of the resulting nanocrystals: a) 5 nm BA-IZO film, b) 10 nm BA-IZO film.

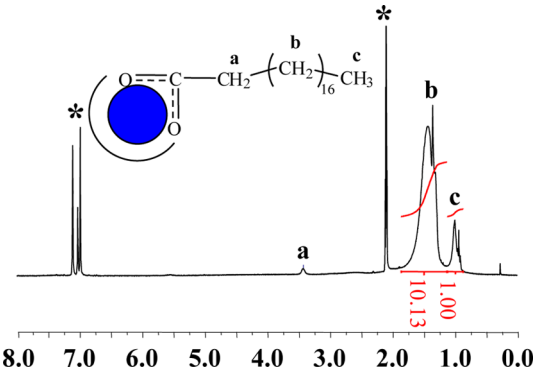

Figure S2a. Nanocrystal sample was dispersed in Toluene-d_8, and the NMR spectra were reference to the residual Toluene peaks at 2.08 ppm, 6.97 ppm, 7.01 ppm and 7.09 ppm. To determined the surface capping group, first, the distinct peak at 3.42 ppm presented **a** ($-CH_2$) neared the carboxylic group, second the integrated alkyl area under the peak of ($-CH_2$) denoted **b** was compared to that under ($-CH_3$) denoted **c**. The ratio of these peak was found to be 10.13 : 1.00 which close to the expected value of 16[$-CH_2$] (**b**) :1[$-CH_3$] (**c**). Therefore, IZO NCs was capped with stearic acid.

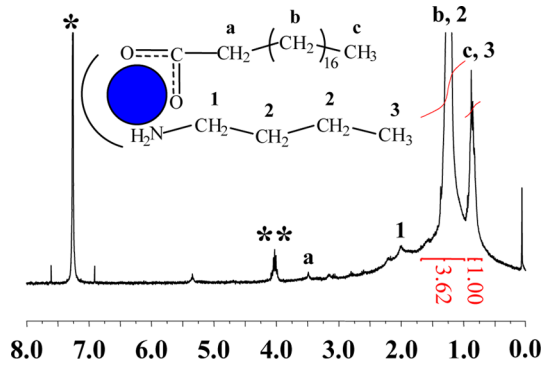

Figure S2b. By the presence of butylamine, which contributes seven protons per molecule to the alkyl area. In this figure, the ratio area of (-CH_2) and (-CH_3) peak in alkyl area was seen to increase to 3.62 : 1.00. From this ratio we can determine the ligand-exchange percent of butyl amine.

We assume that we have two variables need to determine was x and y. With x times of butylamine capped on the particle surface and y times of stearic acid remain.

x [CH_3-CH_2-CH_2-CH_2-NH_2] and y [CH_3-$(CH_2)_{16}$-CH_2-COO-]

After ligand exchange, the CH_3 peak and CH_2 peak in alkyl area was distributed for both new ligand – butylamine and stearic acid – remaining ligand. Therefore, we have equation to calculate the ratio between x and y:

$$\frac{3(x+y)}{4x+32y} = \frac{1}{3.62} \quad (1)$$

with 3(x + y) was integral area of CH_3- group and (4x + 32y) was intergral area of –CH_2 group. Calculating Eq. (1) gave the ratio of x : y = 3.08, therefore, ligand-exchange percentage was 75%.

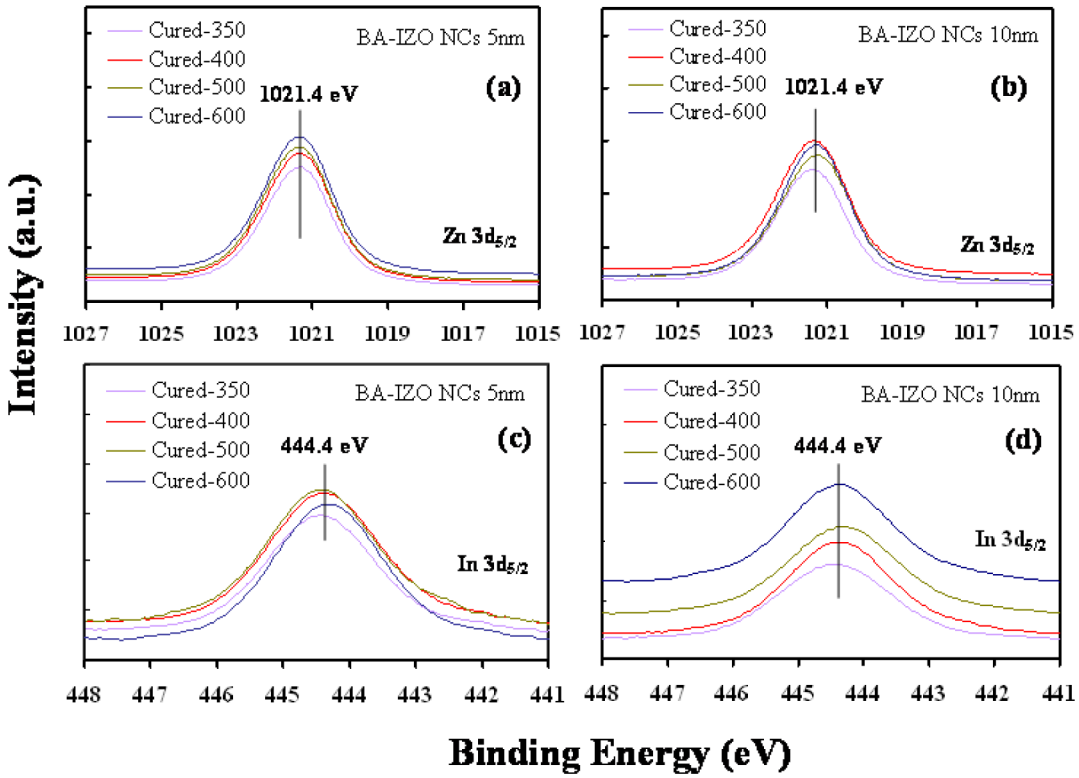

Figure S3. XPS results of Zn $2p_{3/2}$ and In $3d_{5/2}$ BA-IZO NC 5nm and 10 nm thin films annealed from 350-600 ºC

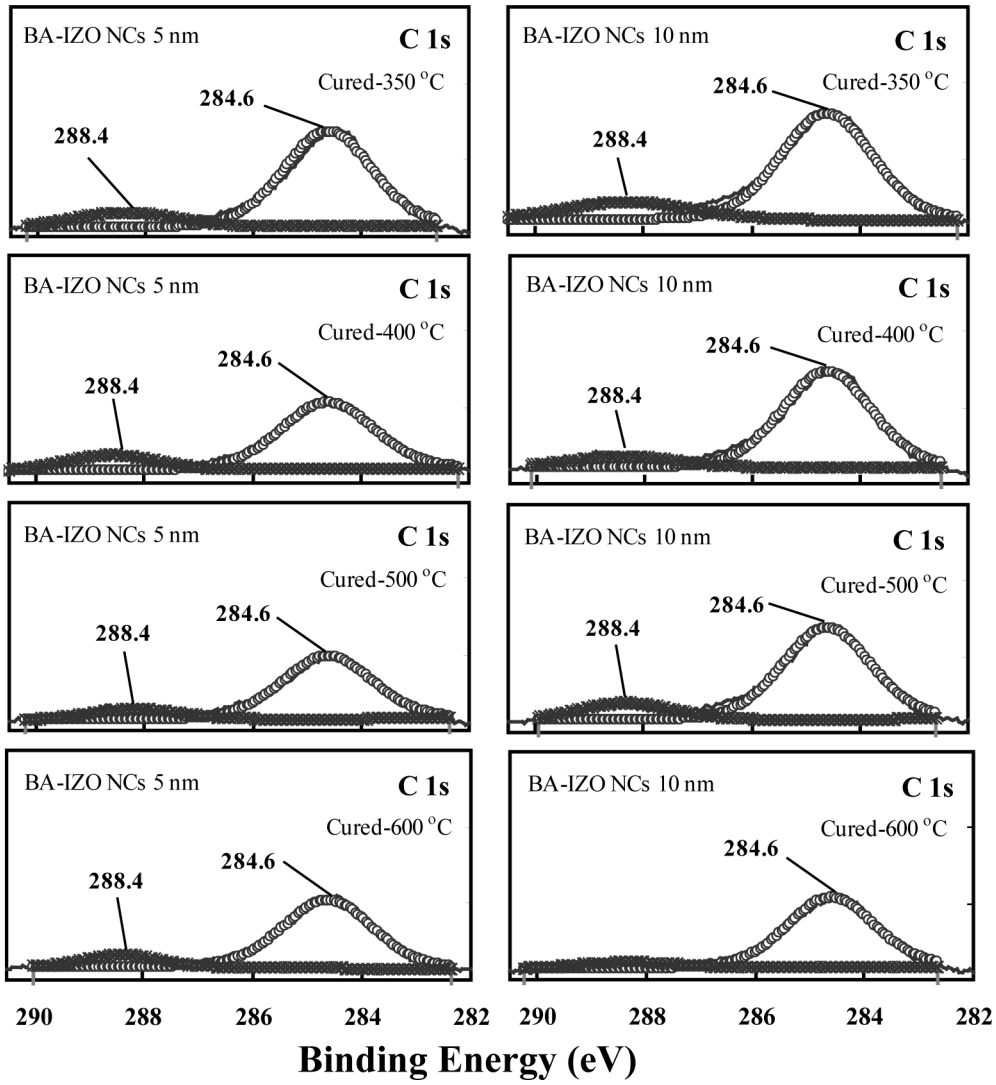

Figure S4. C 1s XPS spectra of the BA-IZO NCs 5nm and 10 nm thin films annealed at different temperature: 350 ºC-600 ºC. Note: C 1s peak at 284.6 eV presented for C-C bonding, C 1s peak at 288.4 eV presented for O=C-OH (carboxyl), C-N bonding.

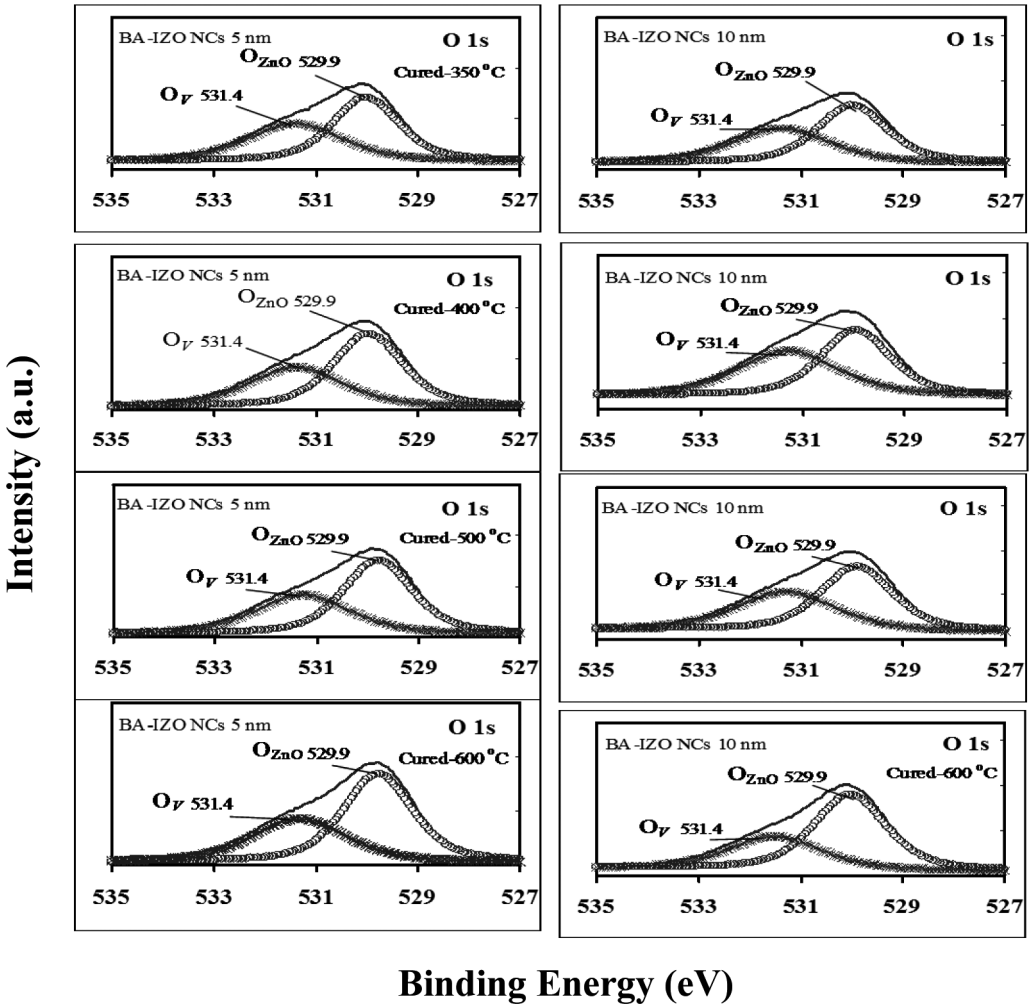

Figure S5. O 1s XPS spectra of the BA-IZO NCs 5nm and 10 nm thin films annealed at different temperature: 350 ºC-600 ºC. Note: O_{ZnO} centered at 529.9 eV was concerned with O^{-2} ions in the oxygen of the hexagonal wurtzite structure. The O_V peak at 531.4 eV reflected oxygen vacancies in structure.