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

Supplementary Information

Remarkable Photocurrent of P-type Dye-sensitized Solar Cell Achieved by Size Controlled $CuGaO_2$ Nanoplates

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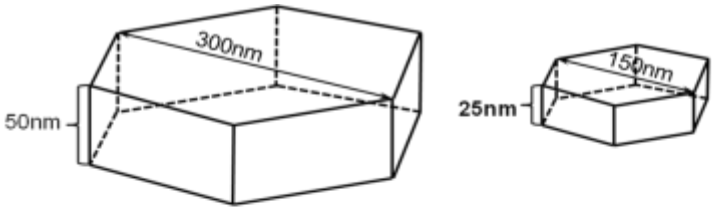

$$BET_1 = \frac{S_1}{V_1 * \rho} \qquad BET_2 = \frac{S_2}{V_2 * \rho}$$

$$S_1 = 2 * \frac{3\sqrt{3}}{8} * 300^2 + 6 * 50 * 300 \qquad S_2 = 2 * \frac{3\sqrt{3}}{8} * 150^2 + 6 * 25 * 150$$

$$V_1 = \frac{3\sqrt{3}}{8} * 300^2 * 50 \qquad V_2 = \frac{3\sqrt{3}}{8} * 150^2 * 25$$

$$\frac{BET_1}{BET_2} = \frac{S_1}{S_2} * \frac{V_2}{V_1} = \frac{2 * \frac{3\sqrt{3}}{8} * 300^2 + 6 * 50 * 300}{2 * \frac{3\sqrt{3}}{8} * 150^2 + 6 * 25 * 150} * \frac{\frac{3\sqrt{3}}{8} * 150^2 * 25}{\frac{3\sqrt{3}}{8} * 300^2 * 50} = \frac{1}{2}$$

Fig. S1. Calculation on the BET surface area difference between two kinds of ideal hexagonal nanoplates, one with 150 nm diameter and 25 nm thickness, another one with 300 nm diameter and 50 nm thickness, the size of which are just corresponding to the nanoplates synthesized from 5 °C and 25 °C precursors respectively.

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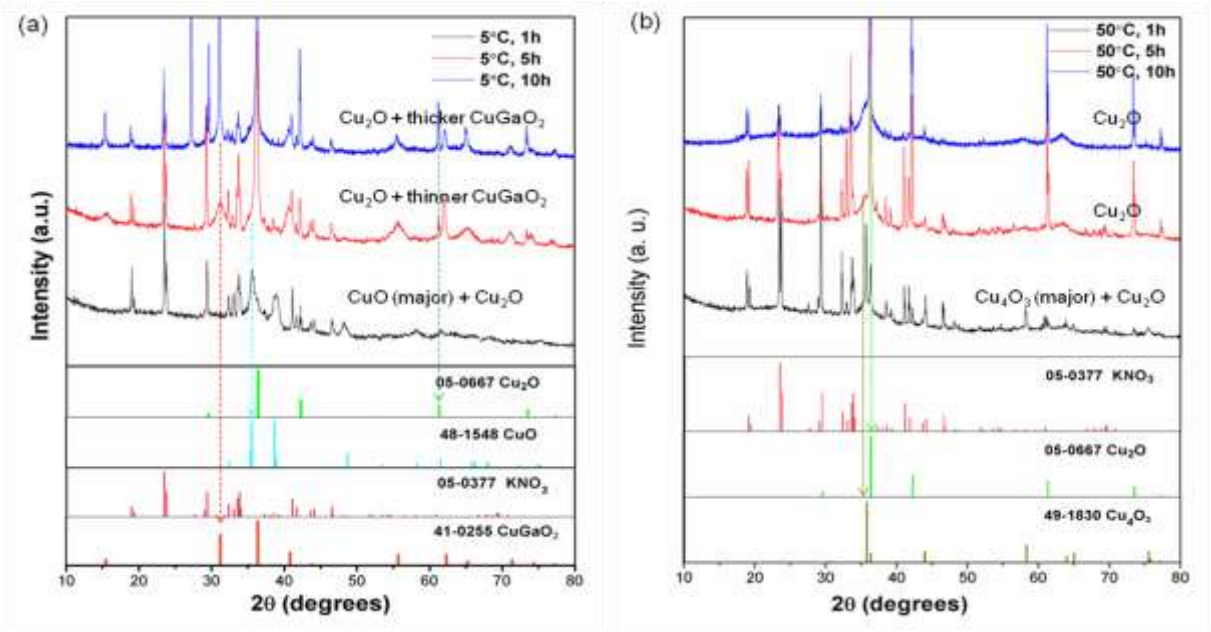

Fig. S2. XRD patterns of the intermediates obtained after hydrothermal treatment on (a) the 5 °C precursor and (b) the 50 °C precursor for 1 hour, 5 hours and 10 hours, respectively.

For the 5 °C precursor, it can be found a general phase transition from $Cu_2(OH)_3NO_3$, to CuO, subsequent to Cu_2O, and gradually to $CuGaO_2$ in the first several hours of hydrothermal synthesis. After 5 hours, the $CuGaO_2$ nanoplates begin to form. The thickness of $CuGaO_2$ nanoplates becomes thicker after 10 hours hydrothermal synthesis. Such processes can be judged from the peaks labeled by the red arrow owning to $CuGaO_2$. For the 50 °C precursor, it can be found that the phase transition is as follows: CuO to Cu_4O_3, and subsequent to Cu_2O. After 10 hours hydrothermal treatment, no $CuGaO_2$ nanoplates have formed. It might be due to that the preformed CuO excessively grows to too thick Cu_2O seeds, hindering the subsequent Ga^{3+} diffusion into the Cu_2O lattice. So, the phase transition from Cu_2O to $CuGaO_2$ has been retarded. It is obviously that, the Cu_2O seeds formation time is much shorter for the 5 °C precursor than that for the 50 °C precursor, which might be responsible for the different size control effect on Cu_2O and $CuGaO_2$ nanoplates.

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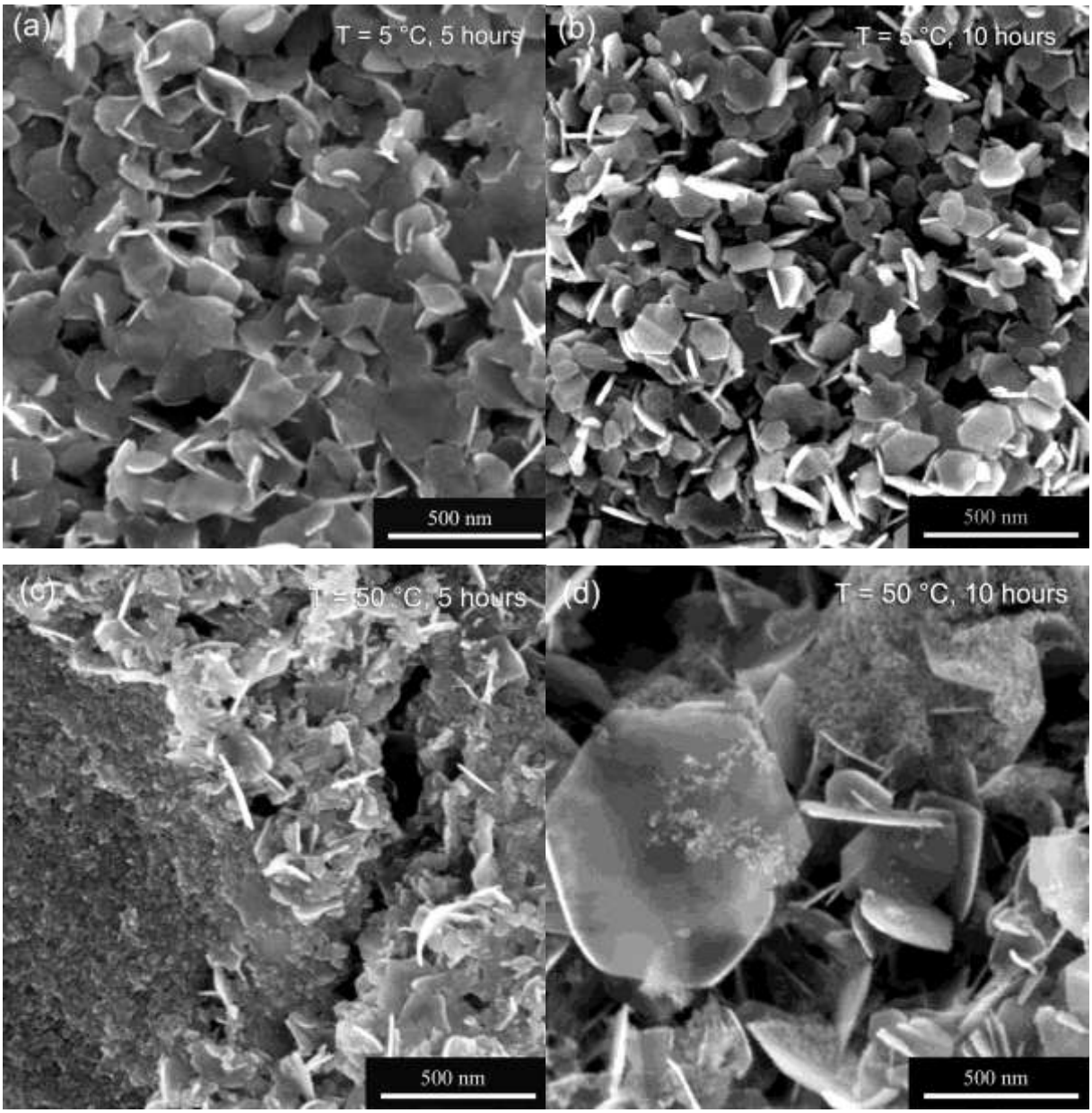

Fig. S3. SEM images of the intermediates obtained after hydrothermal treatment on the 5 ℃ precursor for (a) 5 hours and (b) 10 hours, and the 50 ℃ precursor for (c) 5 hours and (d) 10 hours, respectively.

Obviously, the intermediates obtained from the 5 ℃ precursor are much smaller and more uniform than from the 50 ℃ precursor. From Fig. S3, it is known the Cu_2O and $CuGaO_2$ are both with the morphology of hexagonal nanoplates. The nanoplates in Fig. S3a are observed thinner than that in S3b.

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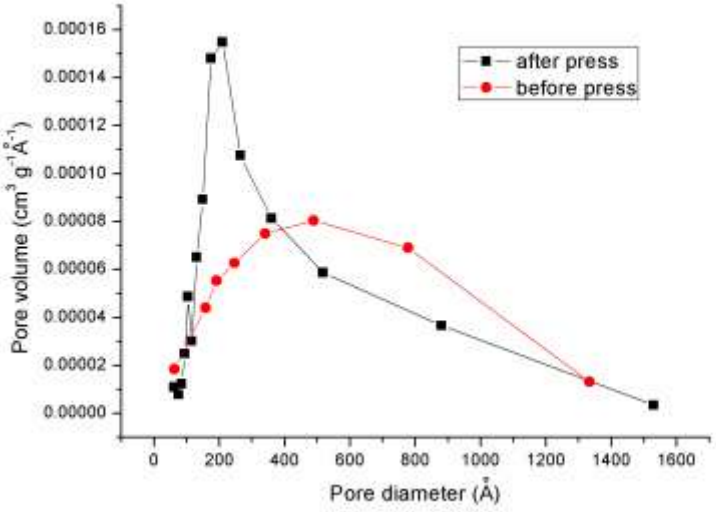

Fig. S4. Pore size distributions of $CuGaO_2$ nanoplates films before and after mechanical press.