Supporting Information

Synthesis of boehmite-type GaOOH: a new polymorph of Ga oxyhydroxide and geochemical implications

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Preparation of boehmite template

In a typical procedure, 2344 mg of $Al(NO_3)_3 \cdot 9H_2O$ was first dissolved into 50 mL of purified water, followed by the addition of 300 mg of $(NH_2)_2CO$ under continuously stirring at room temperature to form a clear solution. The solution was then transferred to Teflon-lined stainless-steel autoclave (100 ml capacity). The hydrothermal vessel was heated to 175 $^{\circ}$C, and maintained for 4 hours. After natural cooling, the product was collected by centrifugation, washed three times with purified water, and dried in a vacuum oven at 60 $^{\circ}$C overnight.

The synthesized template boehmite was examined by XRD, FESEM and TEM techniques. As can be seen from Fig. S1a, the peaks at 2θ values of 14.4° (020), 28.1° (120), 38.3° (031), 45.7° (131), 48.9° (051), 49.2° (200), 51.5° (220), 55.2° (151), 60.5° (080), 64.0° (231), 64.9° (002), 66.1° (180) and 71.9° (251) match well with orthorhombic boehmite phase (JCPDS No. 21-1307). The FESEM and TEM images in Fig. S1b and c show that the synthesized boehmite owns a nanoplates-like structure, which are consistent with the results reported by Dubey et al. (2017). These results confirmed that the template boehmite was successfully synthesized.

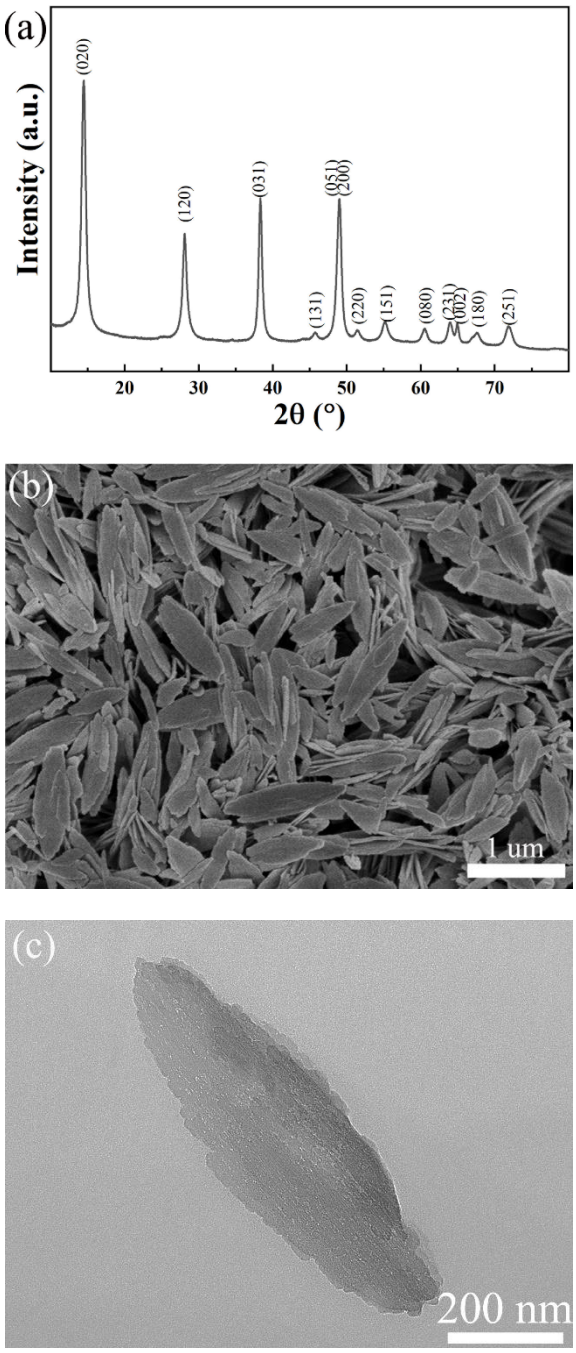
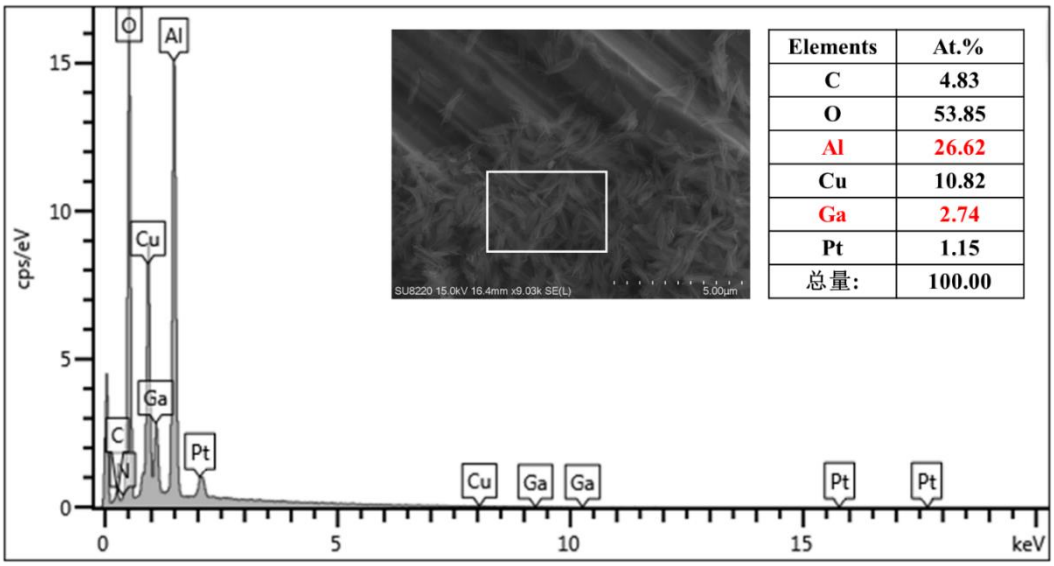


Fig. S1 XRD pattern (a), FESEM (b) and TEM (c) images of the synthesized boehmite template.



Elements	At.%
C	4.83
O	53.85
Al	26.62
Cu	10.82
Ga	2.74
Pt	1.15
总量:	100.00

Fig. S2 EDS spectrum of the synthesized product. Insets are corresponding analytical area and EDS datasheet, respectively.

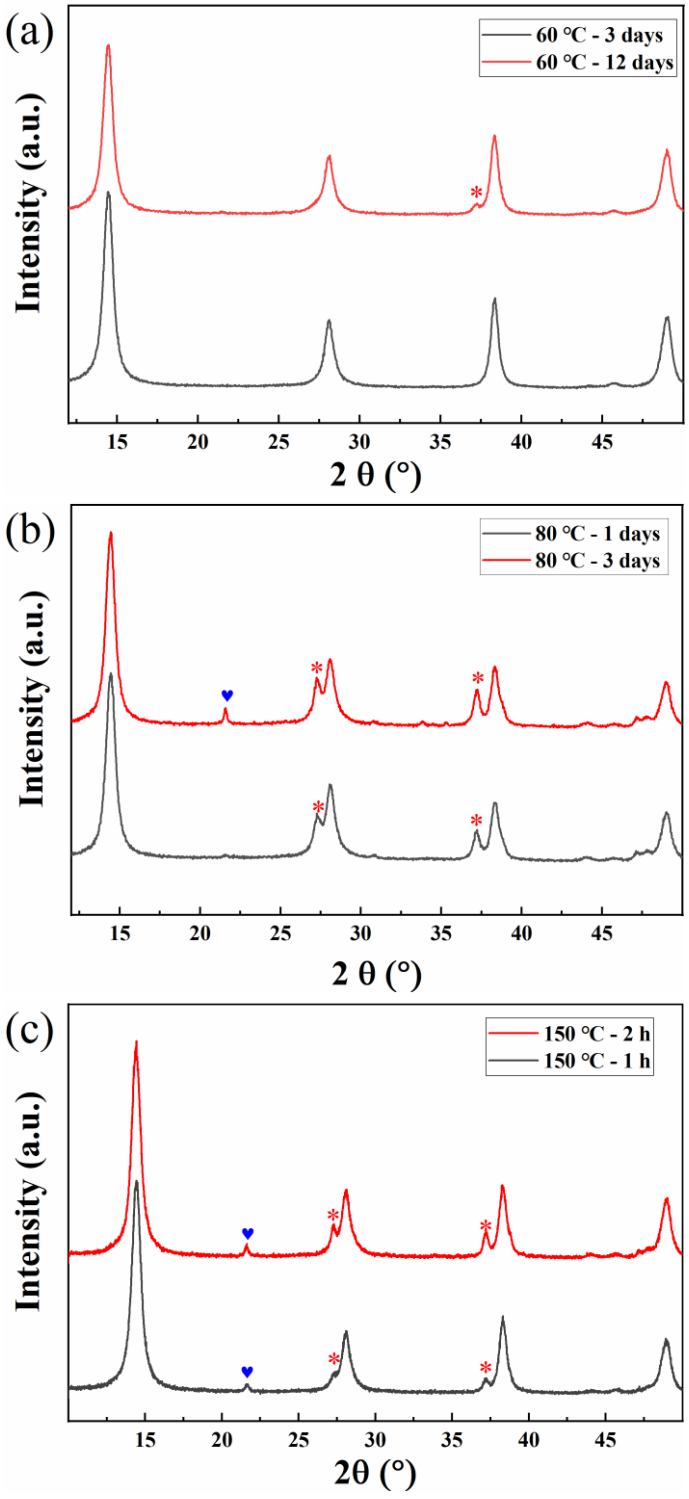


Fig. S3 XRD patterns of the products synthesized at 60 (a), 80 (b) and 150 ℃ (c) for different reaction times. Red asterisks (*) represent γ-GaOOH and blue hearts (♥) represent α-GaOOH

As shown in Fig. S3, the peaks corresponding to the characteristic peaks of γ-GaOOH marked by red asterisks appear in all temperature conditions, indicating that γ-GaOOH can be

obtained at the set temperature. In addition, with the increase of aging temperature, the occurrence time of the characteristic peaks of γ-GaOOH becomes shorter and shorter, from 12 days at 60 ℃ to 1 day and 1 hour at 80 and 150 ℃, respectively, indicating that the γ-GaOOH is easier to form at higher temperature. Moreover, besides the diffraction peaks indexed to boehmite and γ-GaOOH, a small diffraction peak belonging to α-GaOOH (JCPDS No. 06-0180) marked by blue heart in Fig. S3b and c appears, which indicate that higher temperature is not only conducive to the formation of γ-GaOOH, but also will leads to the formation of α-GaOOH under the conditions explored in this work.

References

Dubey, S.P., Dwivedi, A.D., Sillanpää, M., Lee, H., Kwon, Y.N., and Lee, C. (2017) Adsorption of As(V) by boehmite and alumina of different morphologies prepared under hydrothermal conditions. Chemosphere, 169, 99–106.