## **Supplementary Material**

### 1. Experimental

#### 1.1 Precipitation of MH by GA and AA

For comparison, both GA precipitation and AA precipitation were performed with the same reaction apparatus and the same reaction conditions except using GA or using AA as the precipitant. The precipitation of MH was as follows:

200 mL of 1.2mol·L<sup>-1</sup> MgCl<sub>2</sub> aqueous solution was added to a 1000 mL flask with a mechanical agitator. After the MgCl<sub>2</sub> aqueous solution was heated to the desired temperature under stirring (revolution: 500 rmp), GA from a steel cylinder or AA from a peristaltic pump was introduced into the MgCl<sub>2</sub> aqueous solution from the bottom of the solution. Then, the reaction solution was aged for a further 2h. After the reaction mixture had cooled, the resulting MH precipitate was separated from the reaction solution by filtration. The obtained MH precipitate was washed with water and then dried in a vacuum at 100 °C for 10 h.

In this work, the GA route and the AA route for the precipitation of MH were compared under the following conditions: both the total molar amount of the added ammonia (ammonia solute) and the introducing time of ammonia in the AA route are the same as those in GA route, which means that the adding rate of ammonia was also the same. In the GA route, the GA was introduced with a flow rate of  $0.2 \text{ L}\cdot\text{min}^{-1}$  in 2h. In the AA route, whatever the concentration of AA was used, the total molar amount of the added ammonia (ammonia solute) and the introducing time of ammonia were kept unchanged, that is, the total amount of the added ammonia (ammonia solute) and the introducing time of ammonia were kept unchanged, that is, the total amount of the added ammonia (ammonia solute) was equivalent to the molar amount of  $0.2 \text{ L}\cdot\text{min}^{-1}\times2h$  GA at normal pressure and temperature and the introducing time of ammonia in the reaction solution forms a buffer solution with the resulting NH<sub>4</sub>Cl, and the pH value remains at around 9.5.

#### 1.2 Analytical methods

Scanning electron microscopy (SEM) images were obtained on a LEO 1530 FEG fieldemission scanning electron microscope (Carl Zeiss, Oberkochen, Germany). X-ray diffraction (XRD) patterns were measured with a D8 diffractometer (Bruker, Karlsruhe, Germany) with Cu Kα radiation at a step length of 0.05 °/s. The average particle size and the particle size distribution of the prepared MH were determined on a BT-9300S laser particle-size analyzer (Dandong Bettersize Instruments Ltd., Dandong, China).

# 2 Supporting figures

**Fig. S1** SEM images of the MH products precipitated with GA at (a) 35 °C, (b) 55 °C, and precipitated with 25.0 wt% AA at (c) 35 °C, (d) 55 °C (scale bar in the images= $2\mu m$ ).



Fig. S2 SEM images of the MH products precipitated with (a) GA and (b) 25.0 wt% AA at 90  $^{\circ}$ C (scale bar in the images=1µm).



Fig. S3 Influence of reaction temperature on the conversion of  $Mg^{2+}$  into MH by GA.



Fig. S4 Solubility of ammonia in water at normal pressure.



**Fig. S5** SEM images of the MH products prepared at 75 °C by (a) 8.3 wt% AA, (b) 16.7 wt% AA, (c) 25.0 wt% AA, (d) 37.5 wt% AA and (e) GA (scale bar =  $2\mu$ m).

