Supporting Information

Directed tuning of nanostructure from 1D to 3D by doping diverse valent cations

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Experimental details

Materials. MgO (99.9%), ZnO (99.8%), Al2O3 (99.9%) and SnO2 (99.9%) were purchased from Aldrich. Deionized water was electronic grade.

Synthesis. $Mg(OH)_2$ were prepared by direct hydration of commercial MgO powder at 180℃ for 24h. In a typical synthesis, 0.2g MgO powder and 75mL deionized water was mixed and stirred 1h at ambient temperature, then poured into stainless Teflon-Lined 100mL capacity autoclave. The autoclave was sealed and maintained at 180℃ for 24h, and then cooled down to room temperature. The resulting product was collected and washed with deionized water several times and dried at 80℃ in air for further characterization. Zn^{2+} doped $Mg(OH)_2$, Al^{3+} doped $Mg(OH)_2$, Sn^{4+} doped $Mg(OH)_2$, were prepared by direct hydration of ZnO and MgO (Zn/Mg molar ratio, 1:3) mixture, Al_2O_3 and MgO (Al/Mg molar ratio, 1:2) mixture and SnO_2 and MgO (Zn/Mg molar ratio, 1:1) mixture at 180℃ for 72h, respectively. Manipulations of all cations doped cases were similar to the synthesis of pure $Mg(OH)_2$.

Characterization. Morphology and structure of products were measured by scanning electron microscopy (SEM) and transmission electron microscope (TEM) at Electron Microscope Lab, Dalian University of Technology. The SEM (HITACHI, S-4800) and TEM (Tecnai G^2 20 instrument) were operated at an accelerating voltage of 5kV and 200 kV, respectively. The nanoparticles were dispersed in ethanol onto a film 3-4nm thick of amorphous carbon supported by 3000 mesh copper grids. Nanoparticles were deposited onto grid and ethanol was evaporated. The crystal structure and phase purity of the product were characterized by powder X-ray diffraction (XRD) on a Rigaku D/max 2400 X-ray diffractometer equipped with graphite monochromatized Cu Kα radiation (λ=1.5406 Å). A scan rate of 0.02 º s^{-1} was applied to record the pattern in the 2θ range from 10 º to 80 º.

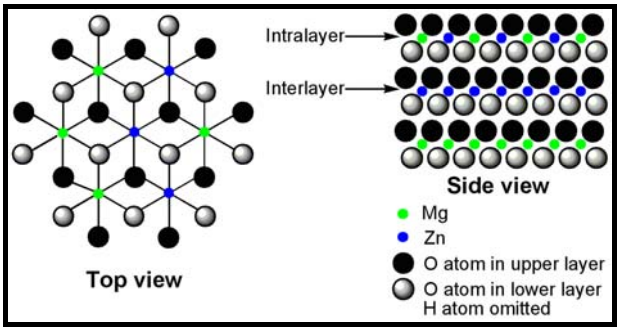

Fig. S1. Example of admixtures in brucite type compounds. Two cases of some Zn^{2+} (blue ones) taking place of Mg^{2+} (green ones) are intralayer and interlayer. Isomorphic substitution of Mg^{2+} in the brucite structure by Zn^{2+} would cause inconspicuous distortion.

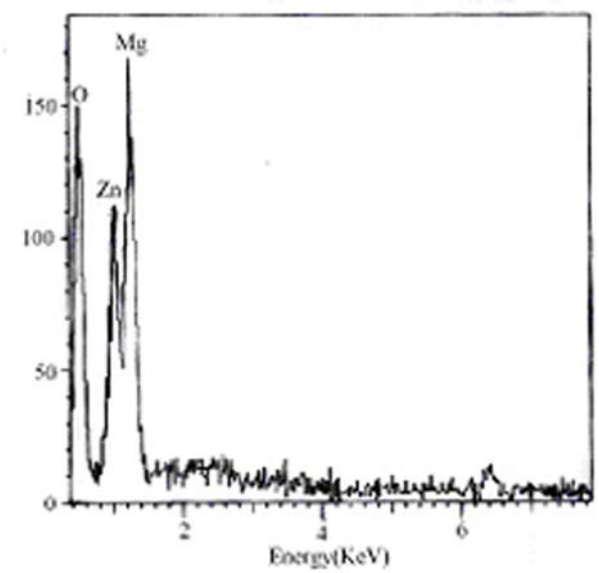

Fig. S2 EDX analysis of Zn-doped $Mg(OH)_2$. Zn/Mg molar ratio is 1:3.

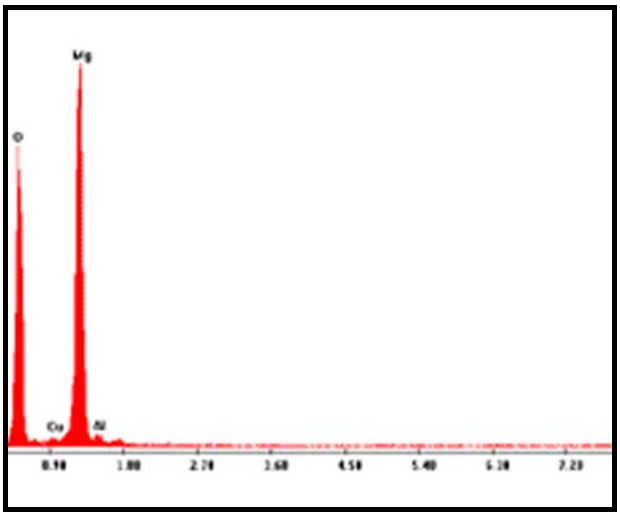

Fig. S3 EDX analysis of Al-substitution $Mg(OH)_2$ dissolved in NaOH solution. The analysis correspond to the SEM images of the samples shown in Fig. S5a.

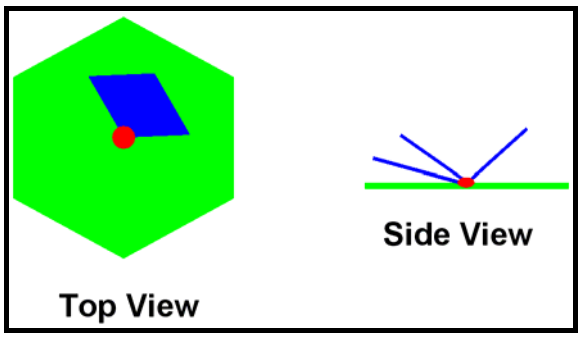

Fig. S4. Illustration of phase distribution of brucite and boehmite. The green and blue zone displays brucite. The red zone presents boehmite. SEM images (Fig. S5, Supporting Information) would further clarify the proposed illustration.

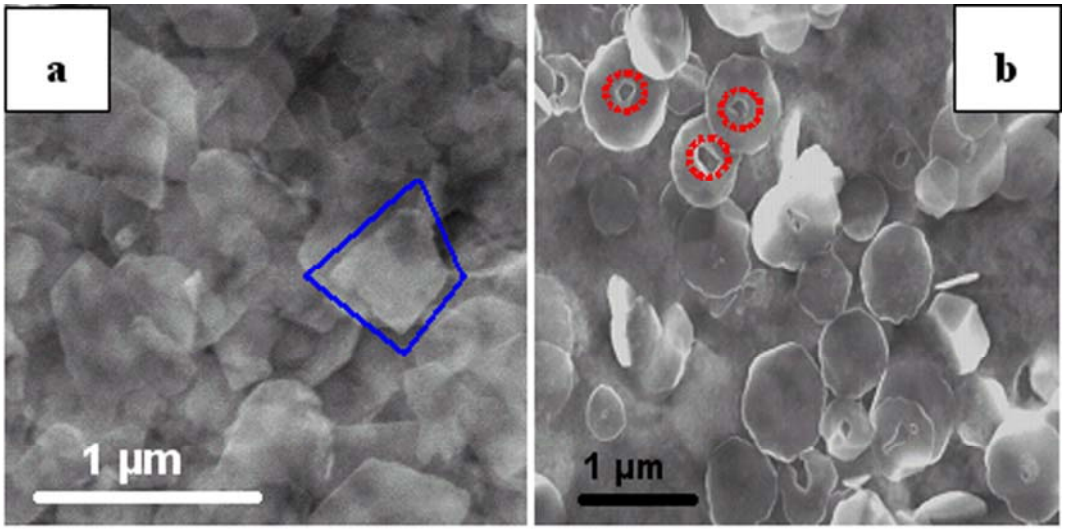

Fig. S5 (a) SEM images of Al-substitution $Mg(OH)_2$ dissolved in NaOH solution. Tetragonal and hexagonal nanosheets derived from rose-like structures as joint region (boehmite phase) between receptacle and petals was dissolved in NaOH solution. (b) SEM image of initial Al-substitution $Mg(OH)_2$ dissolved in NaOH solution. This sample was prepared at the same condition as the product in Figure 2c, only truncated hydrothermal reaction time for 24h. Centre bore formed by way of NaOH solution etching.

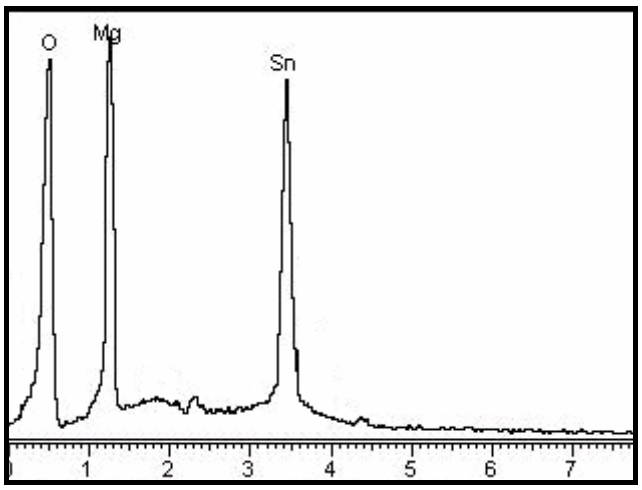

Fig. S6 EDX analysis of Sn-doped $Mg(OH)_2$. Sn/Mg molar ratio is 1:1.