

Electronic supplementary information (ESI)

Chemical control of struvite scale by a green inhibitor polyaspartic acid

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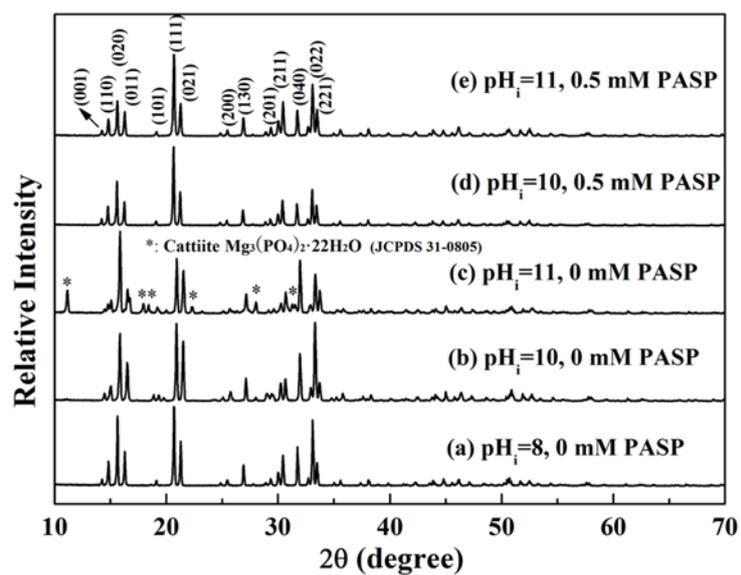


Figure S1. XRD patterns of the samples precipitated at pH_i 8 (a), 10 (b), 11 (c) dosed with 0 mM PASP; and at pH_i 10 (d), 11 (e) dosed with 0.5 mM PASP.

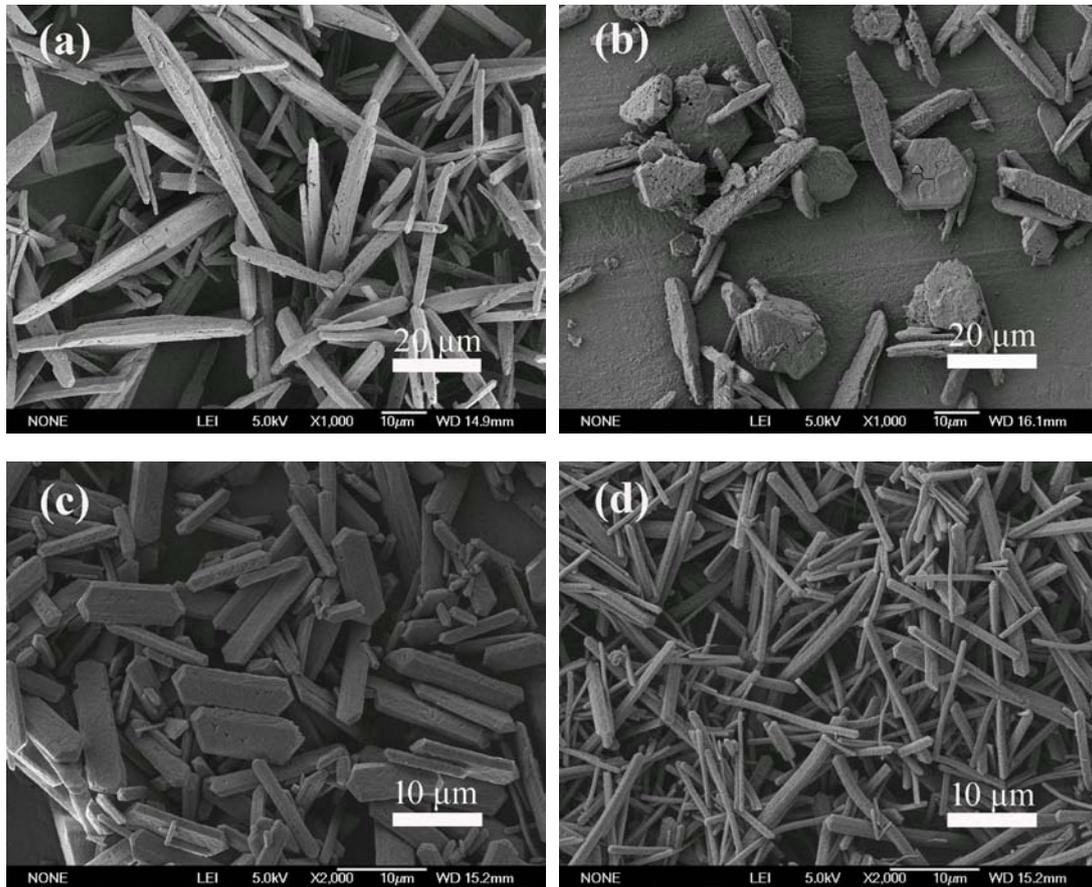


Figure S2. FESEM images of the precipitates at pH_i 10 (a), 11 (b) dosed with 0 mM PASP, and at pH_i 10 (c), 11 (d) dosed with 0.5 mM PASP.

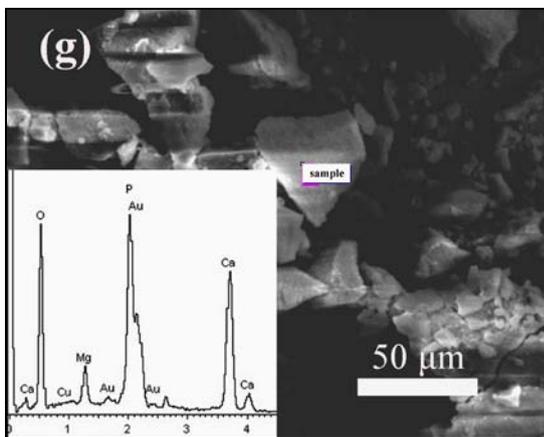
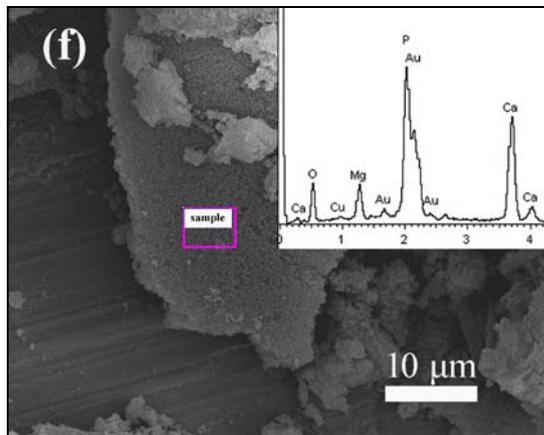
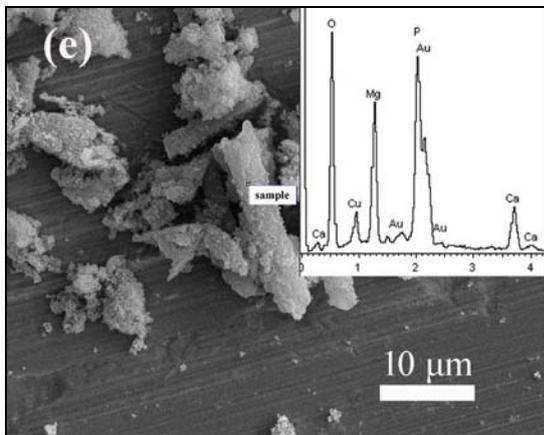
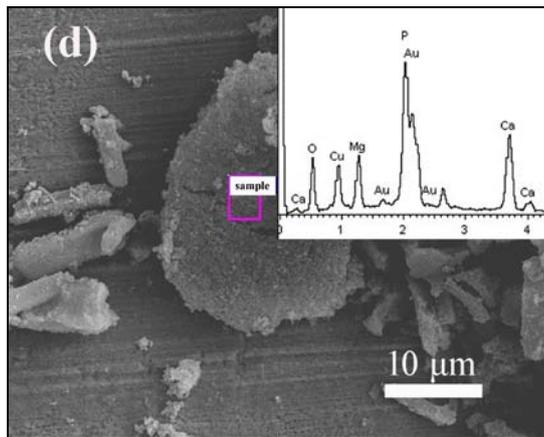
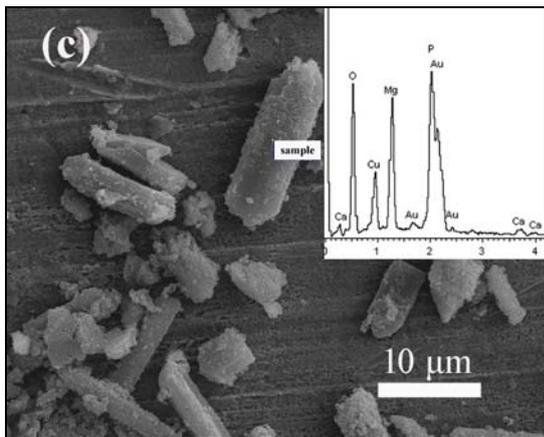
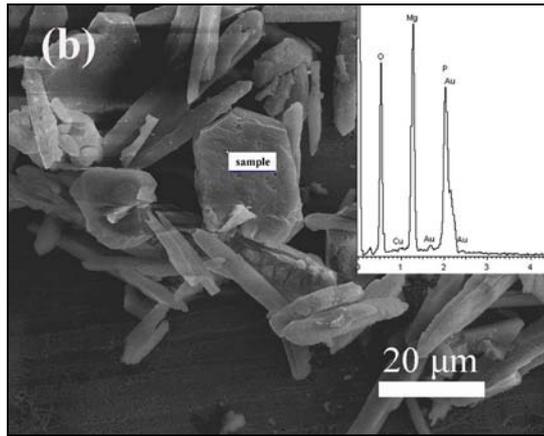
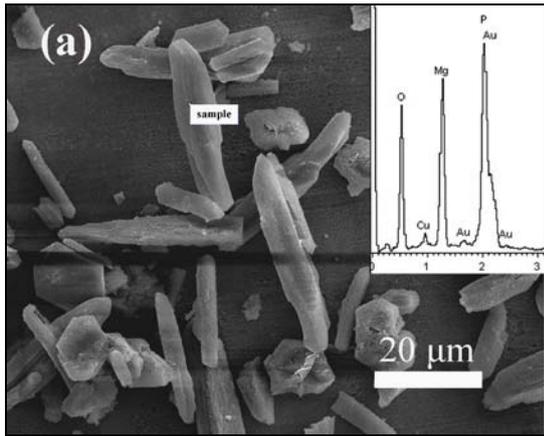


Figure S3. EDX spectra of the precipitates obtained at pH_i 11 with 0 mM PASP (a, b), or Mg/Ca ratio 2:1 (c, d), 1:1 (e, f), 1:2 (g) with 0 mM PASP.

The EDX analysis was also used to identify the elemental composition of the precipitates obtained at pH_i 11 or different Mg/Ca ratios without PASP. The XRD pattern (Figure S1c) and FESEM image (Figure S2b) reveal that only two kinds of crystalline substances, i.e., struvite ($\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$) and cattiiite [$\text{Mg}_3(\text{PO}_4)_2 \cdot 22\text{H}_2\text{O}$], were harvested at pH_i 11 without PASP. The EDX spectra of the rod-shaped and plate-like crystals both show the strong peaks for Mg, P, and O, which are the major elements composing struvite or cattiiite in mass percentage (Figure S3a and b). However, the relative intensity between Mg and P are opposite in the two EDX spectra. According to the chemical formulae of struvite and cattiiite, the latter has stronger Mg/P ratio in mass percentage. Therefore, the plate-like crystals are cattiiite, and the rod-shaped crystals are struvite. Similarly, the FESEM image (Figure S4a) and XRD pattern (Figure 4a) show that only one kind of crystalline substance (i.e. struvite) and an amorphous matter were obtained at Mg/Ca ratio 2:1 without PASP. The EDX spectrum of the struvite-like crystals is shown in Figure S3c. Along with the strong peaks for Mg, P, and O, some distinctive peaks for Ca can also be seen, which may result from the amorphous matter coated on the struvite crystals. The EDX analysis was also conducted on the irregular aggregate (Figure S3d). The higher peaks for P and Ca were observed compared with Mg, revealing that the irregular aggregate is amorphous calcium phosphate (ACP). Likewise, the EDX analysis confirmed that a combination of struvite and ACP were obtained at Mg/Ca ratio 1:1 without PASP (Figure S3e and f), and only ACP was harvested at Mg/Ca ratio 1:2 without PASP (Figure S3g).

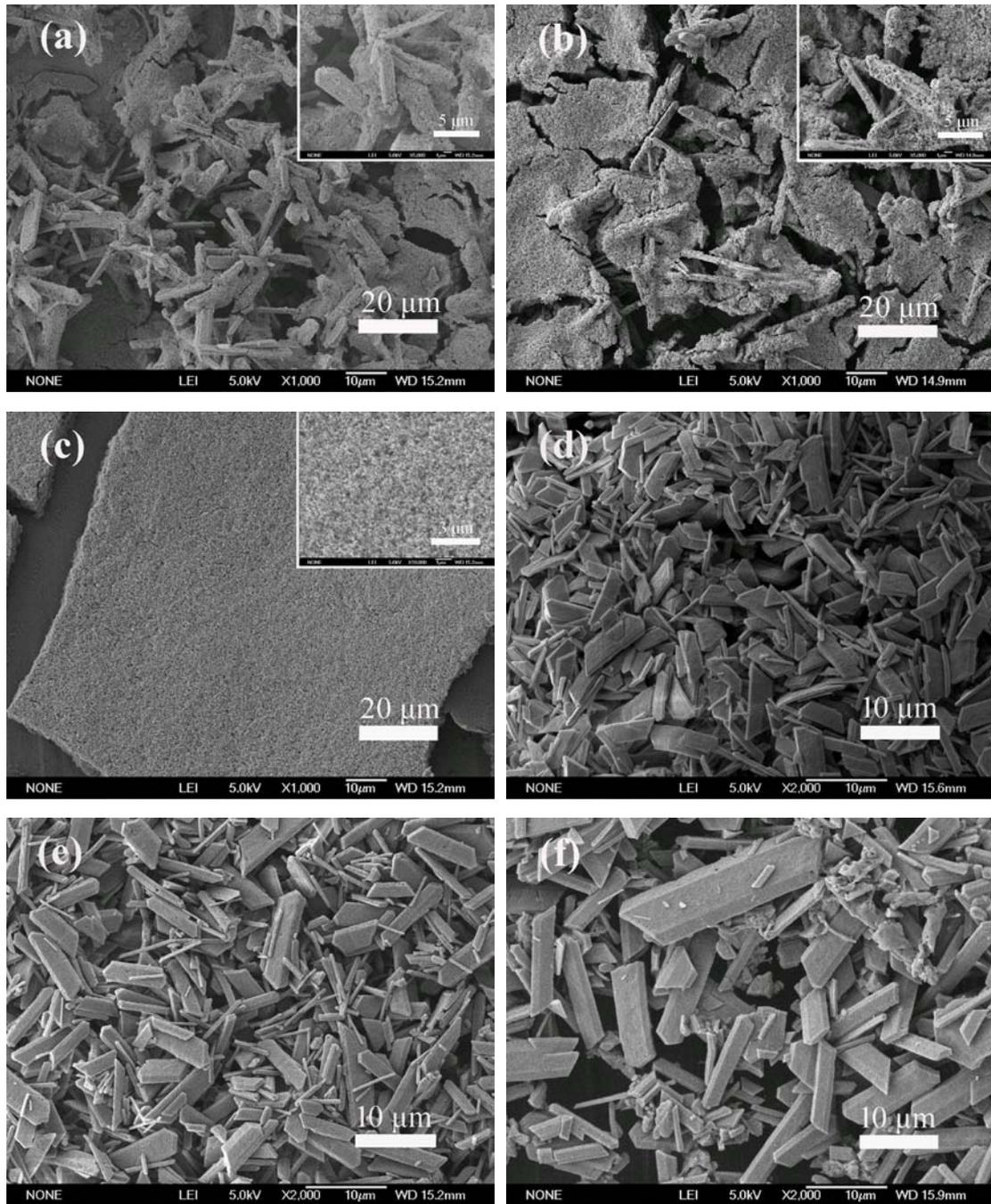


Figure S4. FESEM images of the precipitates at Mg/Ca ratio 2:1 (a), 1:1 (b), 1:2 (c) dosed with 0 mM PASP, and at Mg/Ca ratio 2:1 (d), 1:1 (e), 1:2 (f) dosed with 0.5 mM PASP.

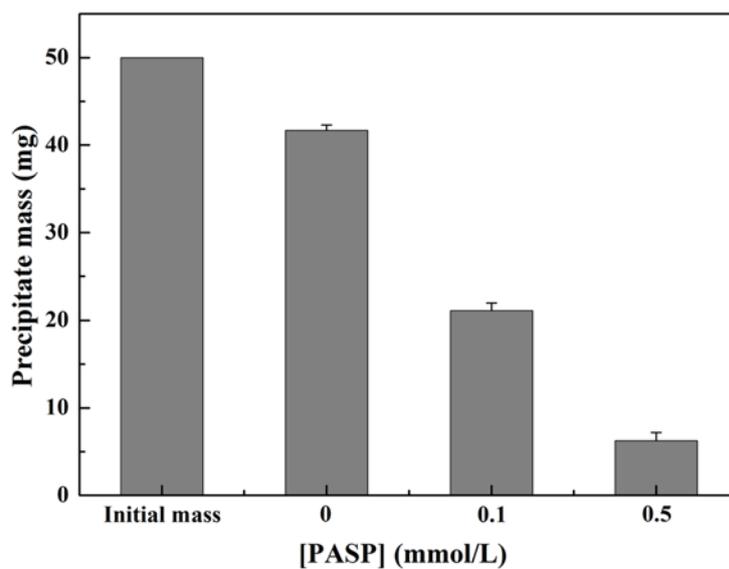


Figure S5. Remaining mass of struvite after dissolution dosed with different concentrations of PASP.