Controlled preparation and formation mechanism of hydroxyapatite nanoparticles under different hydrothermal conditions

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Nanostructural HAP particles with a high surface area would be more desirable for their use in many fields[8], e.g. HAP exists as nanorods in the bone. Hydrothermal reaction is a green and conventional method to prepare HAP materials, but usually with poor control on particle size and shape.

In the work, Hydroxyapatite (HAP) nanoparticles with uniform morphologies and controllable size have been synthesized successfully by molecular template hydrothermal approach. The organic alcohols including ethanol, glycol, glycerol and butanol are used as templates to regulate the nucleation and crystal growth. The synthesized powders were characterized using X-ray diffraction, Fourier infrared spectrum and transmission electron microscopy. The results show that the obtained HAP particles are uniform rod-like crystals, and the template molecular structures have significant effect on the morphology and size of HAP particles. The template molecules with longer hydrophobic alkyl chains favor the HAP crystal growth along c axis of nanorods, resulting in a larger length and aspect ratio, the shorter hydrophobic alkyl chains or more hydroxyl groups are favor of rod-like HAP crystal growth along a axis of nanorods with smaller aspect ratio and shorter length. Compared with the concentration of template molecules, the template molecular structure shows larger influence on controlling the HAP morphology and size. Furthermore, the formation mechanism of these rod-like HAP particles prepared by alkyl alcohol templates is discussed. Moreover, hydrothermal treatment temperature and time can be also used for controlled preparation of HAP nanoparticles.

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