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Thermal decomposition of brushite, $CaHPO_4 \cdot 2H_2O$ to monetite $CaHPO_4$ and the formation of an amorphous phase

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Abstract

Brushite, $CaHPO_4 \cdot 2H_2O$, is a layered structure in which the layers are held together by water molecules via hydrogen bonds. Brushite loses its water molecules in two steps when heated, to form monetite $CaHPO_4$. The loss of water results in the formation of an amorphous phase along with monetite. We investigated the dehydration process primarily by means of X-ray diffraction, and quantified the amount of monetite and the amorphous phase as a function of heating rate and temperature via Rietveld refinements. Water loss was recorded by thermogravimetric analysis and the nature of the products was investigated by Fourier transform infrared spectroscopy. Recrystallization, water loss, and the formation of the amorphous phase depend on the heating rate and/or time of exposure at temperature. The conversion temperature is about 220 °C, although brushite can convert to monetite at lower temperatures during prolonged exposure to heat. More amorphous phase forms during slower dehydration at slower heating rates. The amorphous phase forms due to non-linear dehydration of brushite. The amorphous phase is hydrated and can be regarded as a highly disordered monetite with some free water trapped in the structure.

Keywords: Brushite (DCPD), Monetite (DCPA), thermal analysis, amorphous calcium phosphate (ACP), XRD, TGA