POORLY CRYSTALLINE ("cryptocrystalline") CALCIUM PHOSPHATE (PCA) NANOPARTICLES: BIOMIMETIC SYNTHESIS

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Materials Science and Engineering C: Materials for Biological Applications, 32(5), 1097-1106 (2012).

A robust way of synthesizing poorly crystalline nanobiomaterials:

Biomimetic synthesis steps

1.) Add **500 mL of deionized water** into a 500 mL-capacity glass container (*preferably a clean glass media bottle or beaker*)
2.) Add **0.1865 g KCl** powder and stir to dissolve
3.) Add **0.1525 g $MgCl_2 \cdot 6H_2O$** powder and stir to dissolve
4.) Add **2.776 g NaCl** powder and stir to dissolve
5.) Add **1.1341 g $NaHCO_3$** powder and stir to dissolve
6.) Add **0.7098 g Na_2HPO_4** powder and stir to dissolve

Note-1: Now, one has a transparent (*precipitate-free*) solution mimicking the concentrations of K^+, Mg^{2+}, Na^+, Cl^-, HPO_4^{2-} and HCO_3^- ions of the human blood plasma.

Note-2: The above is how one can only synthesize calcium phosphates "biomimetically."

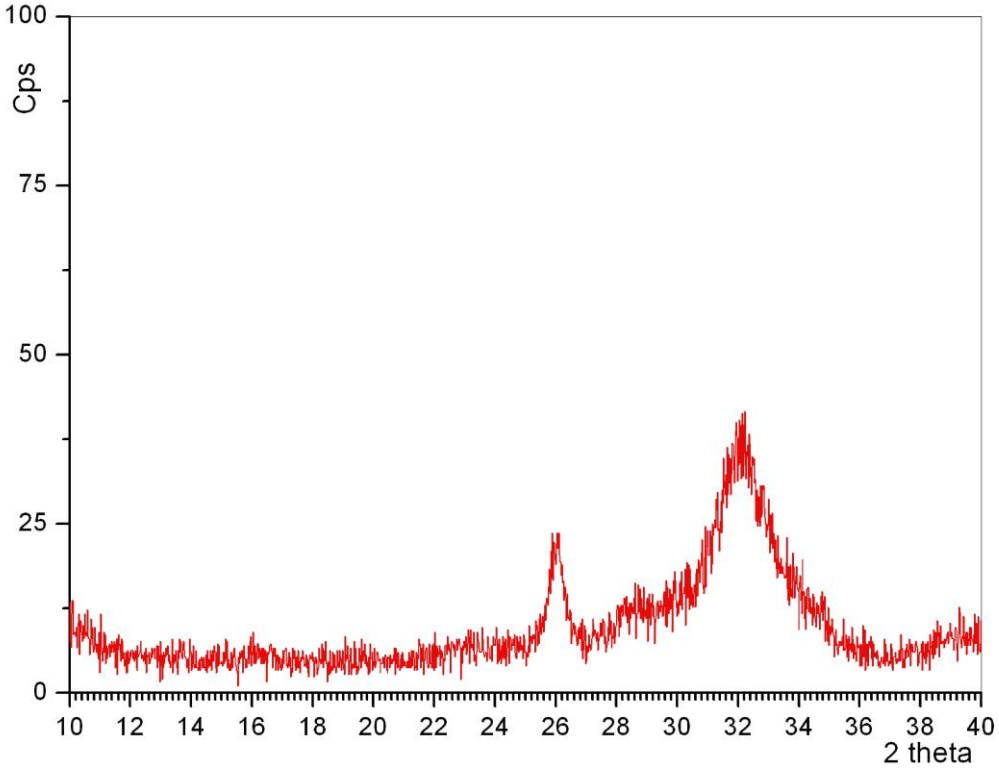
Note-3: Do not forget that mammalian metabolisms do never use deionized or distilled water (*free of the above ions*) as the aqueous medium in synthesizing their hard tissues comprising nanosize carbonated calcium phosphates (*whether x-ray amorphous or cryptocrystalline*).

7.) Add **0.9189 g $CaCl_2 \cdot 2H_2O$** and stir at 500 to 600 rpm for 25 minutes (at room temperature)
8.) Separate the formed precipitates by using filter paper and Buechner funnel
9.) Wash the precipitates with about 750 mL of deionized water
10.) Dry the precipitates at room temperature for 48 h
11.) Cryptocrystalline calcium phosphate powders are ready.

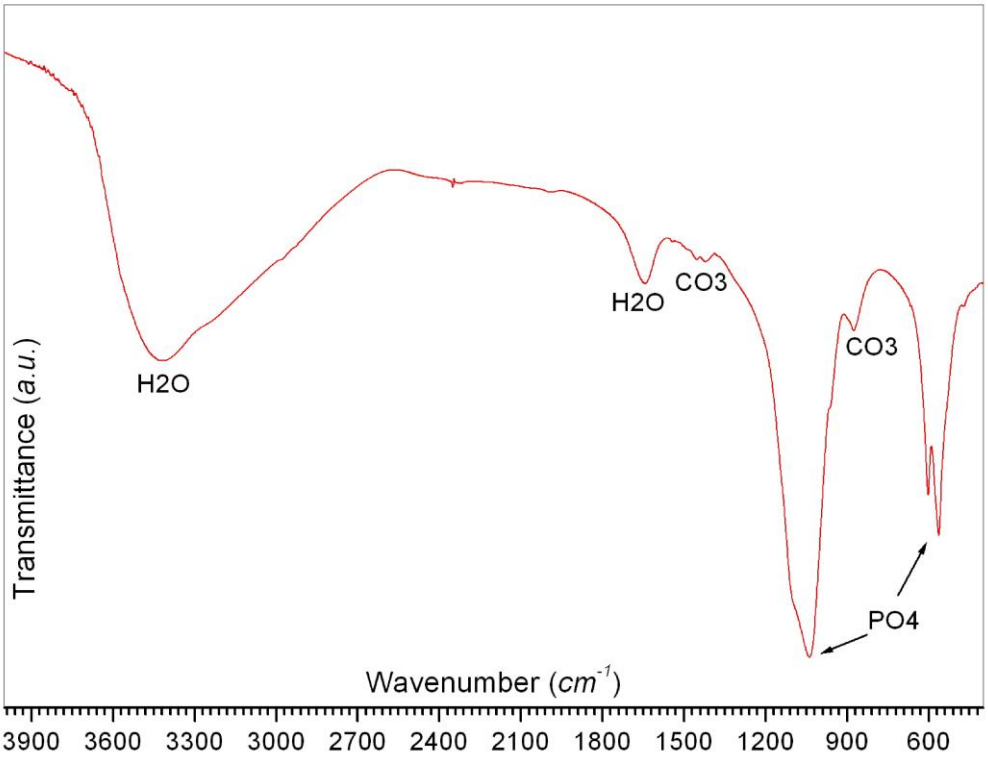
USA patent:

Provisional patent application	**No. 61/597,267 (Feb 10, 2012)**
Utility patent application	**No. 13/759,513 (Feb 5, 2013)**
Patent issued	**No. 9,108,860 (Aug 18, 2015)**

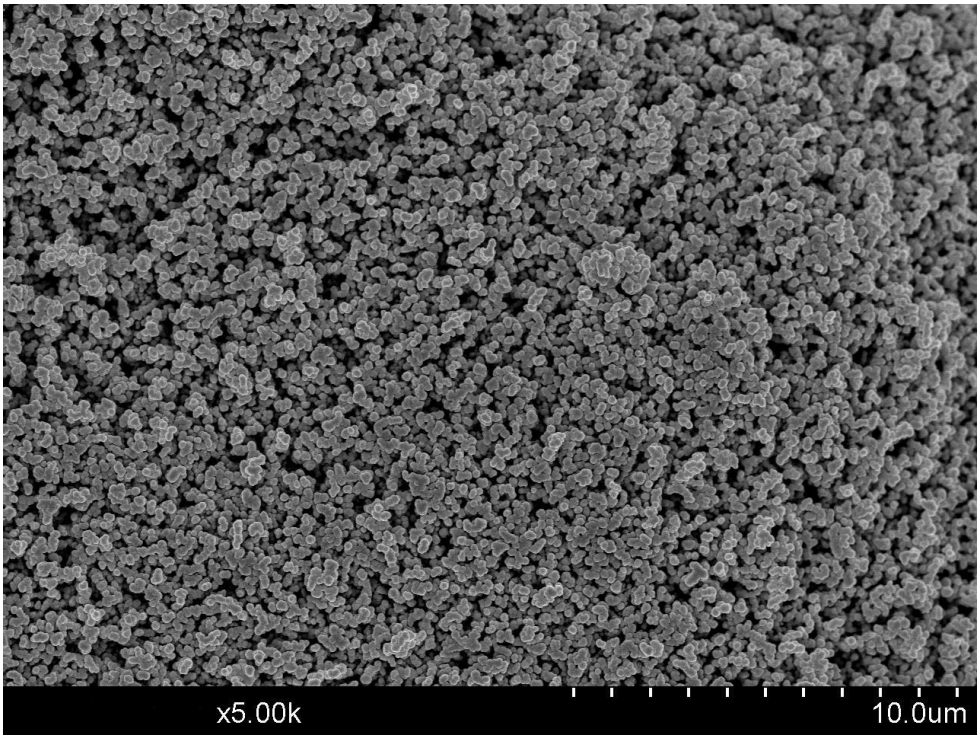
The above synthesis protocol **fixes the pH automatically at 7**. There is no need for any external adjustment or control of pH during the entire synthesis process. The previous literature is full of processes which can only maintain a neutral pH during synthesis (*which is necessary for synthesizing such cryptocrystalline, carbonated, apatitic calcium phosphates*) by the additions of ammonium hydroxide (*or alike*) solutions. Such NH_4OH- (*or NaOH- or KOH-*) dependent processes are now made obsolete by this synthesis protocol.

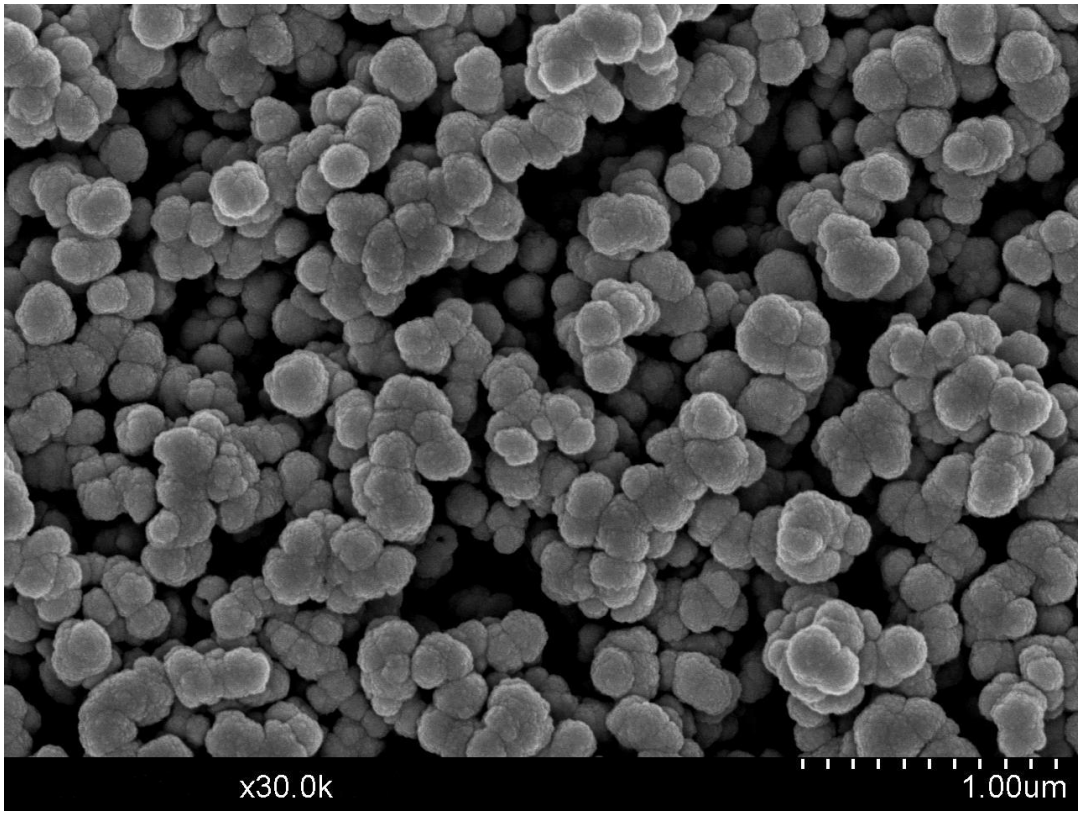


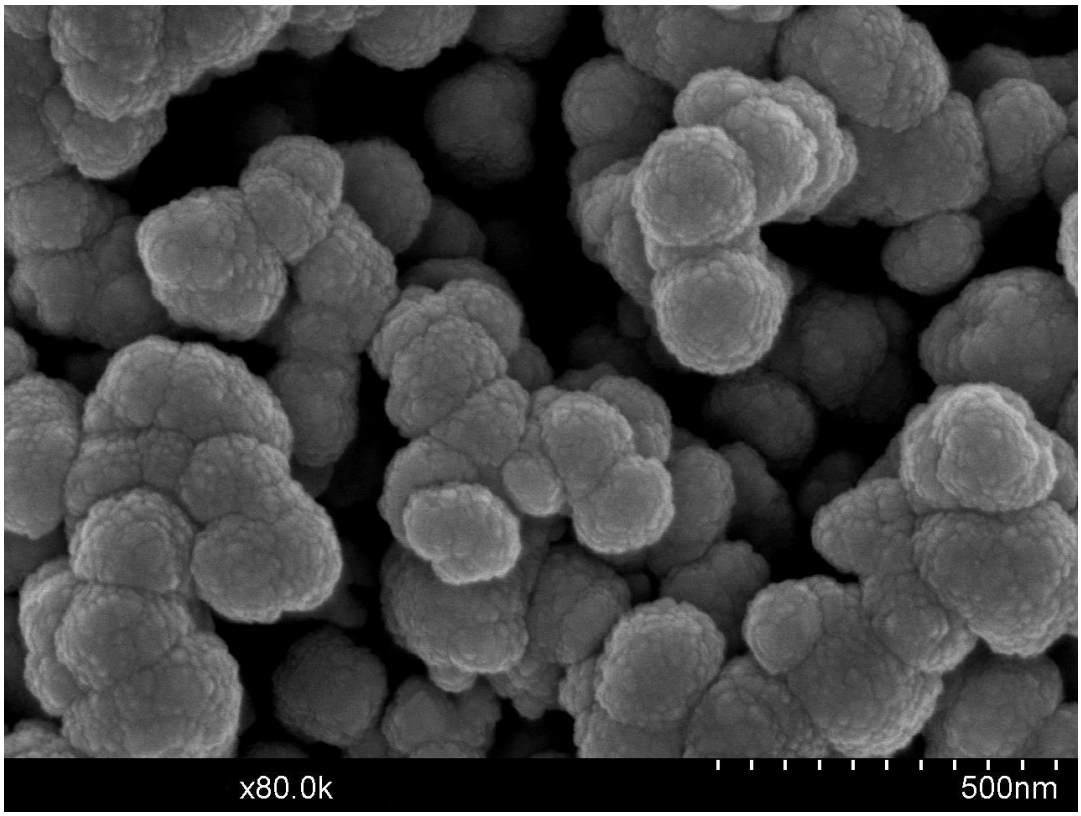
The characteristic powder x-ray diffraction (*40 kV, 30 mA, 0.02 steps, 2 seconds at each step*) chart of the PCA powders is shown above, this is how and why such powders are named as "poorly crystalline" or "cryptocrystalline." The XRD diagrams of human bones resemble the above.

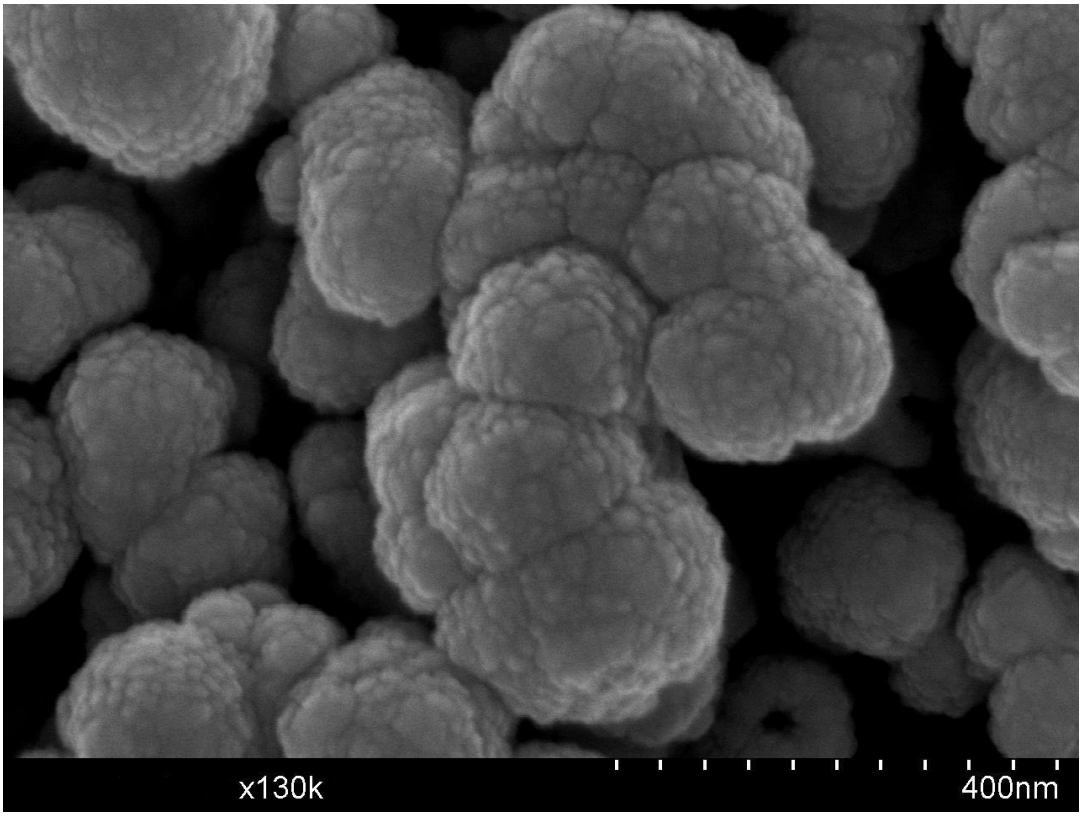


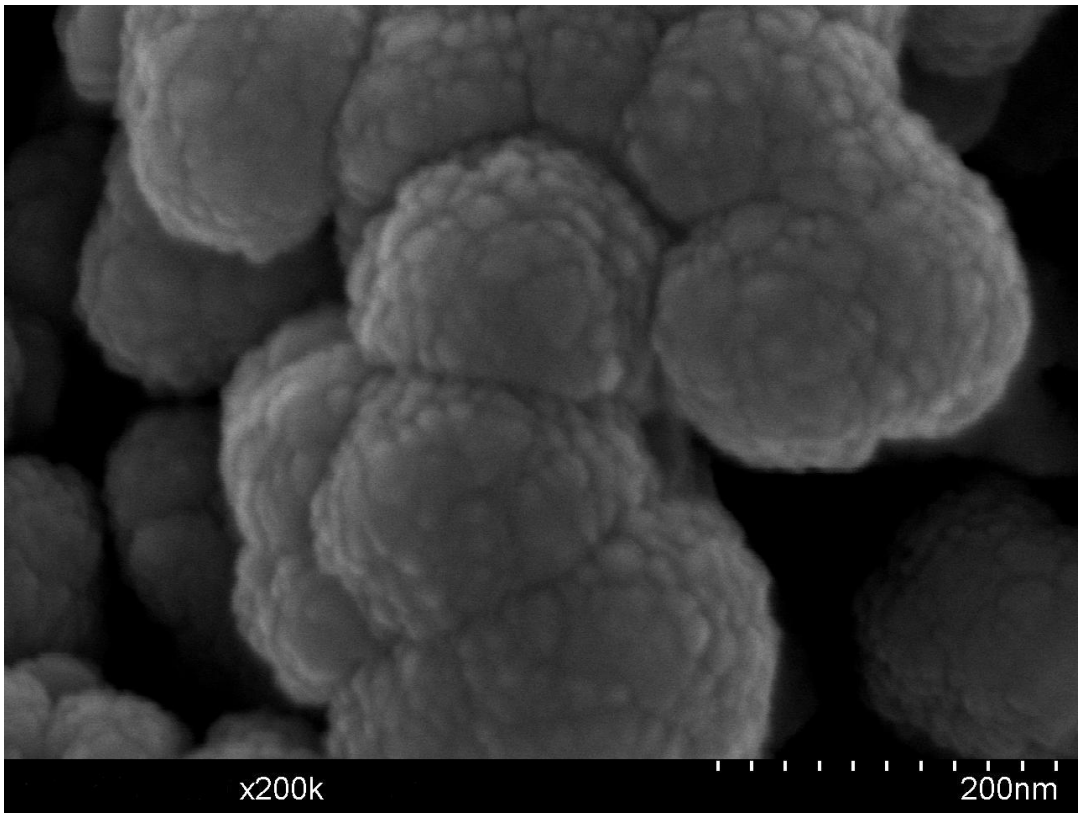
The Fourier-transform infrared (FTIR) spectrogram of the PCA powders (*above*) showed that they are "hydrated and carbonated" apatitic calcium phosphates, just like all the "biomimetic calcium phosphates" should be.




x30.0k
1.00um


x80.0k
500nm





The scanning electron microscope (*SEM*) photos show that the PCA powders are comprised of approximately 110 nm (*nanometer*) particle agglomerates.