# AMORPHOUS CALCIUM PHOSPHATE (ACP) NANOPARTICLES: BIOMIMETIC SYNTHESIS

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Biomimetic synthesis steps

1.) Add **500 mL of deionized water** into a 500 mL-capacity teflon container
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 **0.3549 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 such ions*) as the aqueous medium in synthesizing their hard tissues comprising nanosize carbonated calcium phosphates (whether x-ray amorphous or cryptocrystalline).

Note-4: If you add to the above solution one of the Ca-acetate, Ca-chloride or Ca-nitrate salts (*which researchers rapidly learn from one another as the possible calcium sources*) as the $Ca^{2+}$ source, it is obvious that at that moment you will instantly destroy your "biomimetic solution" by introducing into it acetate or nitrate ions, which are not present in the human blood. If you use Ca-chloride as the $Ca^{2+}$ source, then the $Cl^-$ concentration will be above that of the human blood plasma; again, you will be destroying the above biomimetic solution.

7.) Add **0.2505 g Ca metal** and stir at 500 rpm for 25 minutes (at room temperature)
8.) Filter the formed precipitates by using a No. 42 filter paper
9.) Wash the precipitates with about 750 mL of deionized water
10.) Dry the precipitates at room temperature for 48 h
11.) Amorphous calcium phosphate powders consisting of nanospheres are ready.

**USA patent application:**

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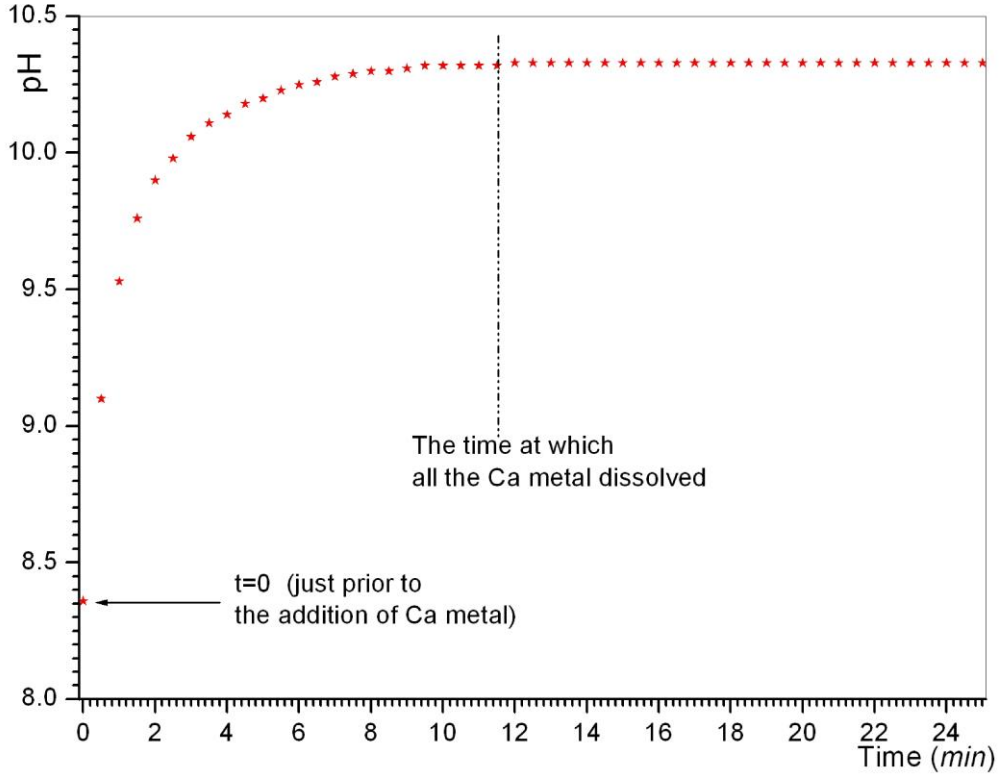
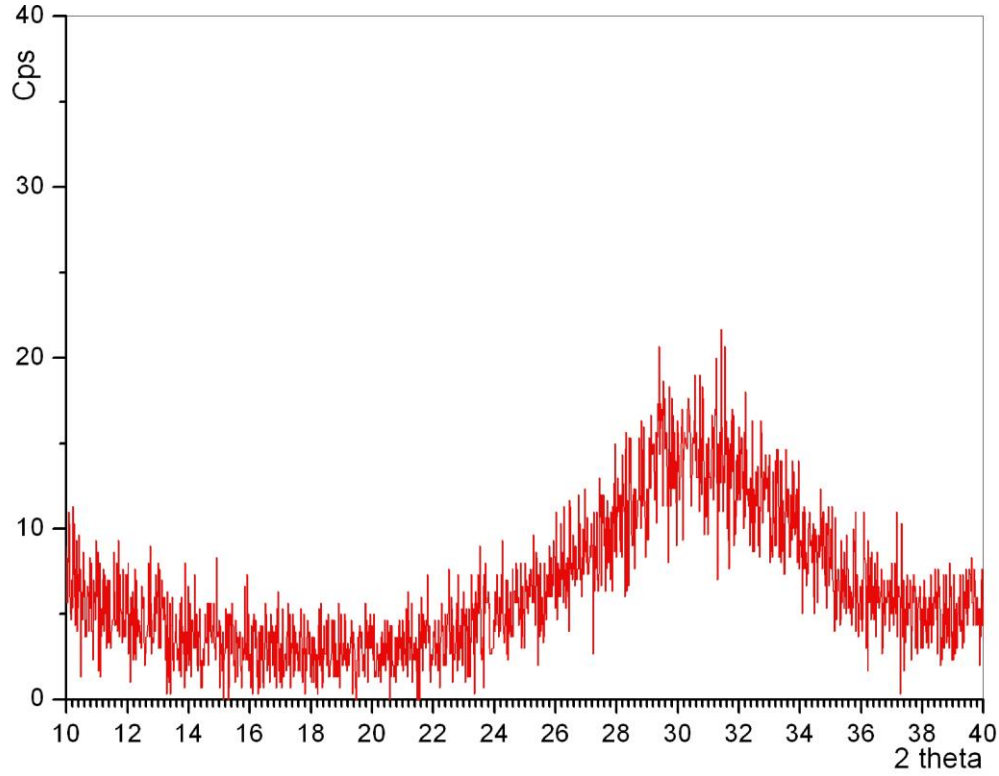
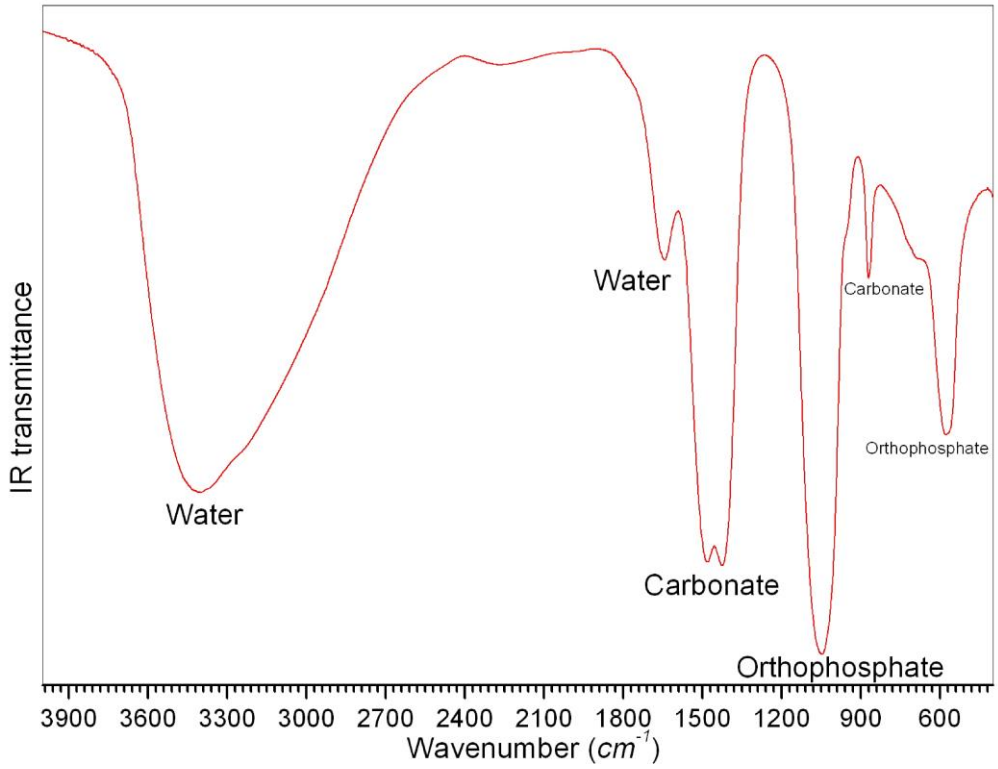
| **Provisional patent application** | **No. 61/597,267 (Feb 10, 2012)** |
| **Utility patent application** | **No. 13/759,513 (Feb 5, 2013)** |
| **Patent issued** | **No. 9,108,860 (Aug 18, 2015)** |



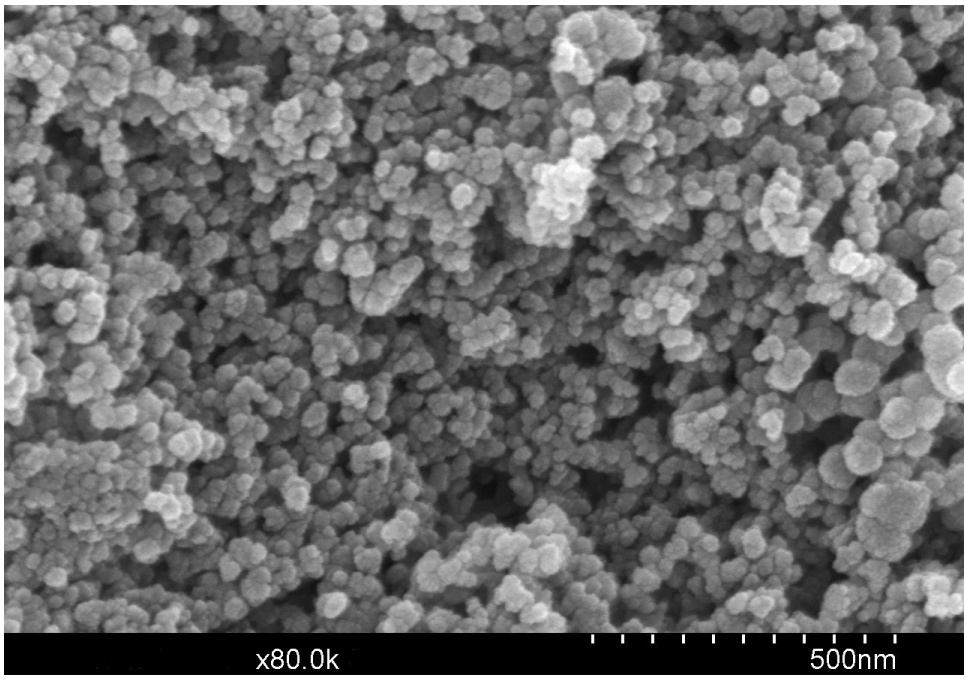

Above is the real-time pH evolution chart. This new process raises the pH automatically. There is no need for any external adjustment or control of pH during the entire synthesis process. The previous literature is full of processes which can only maintain a basic pH (*which is necessary for synthesizing such 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 development.

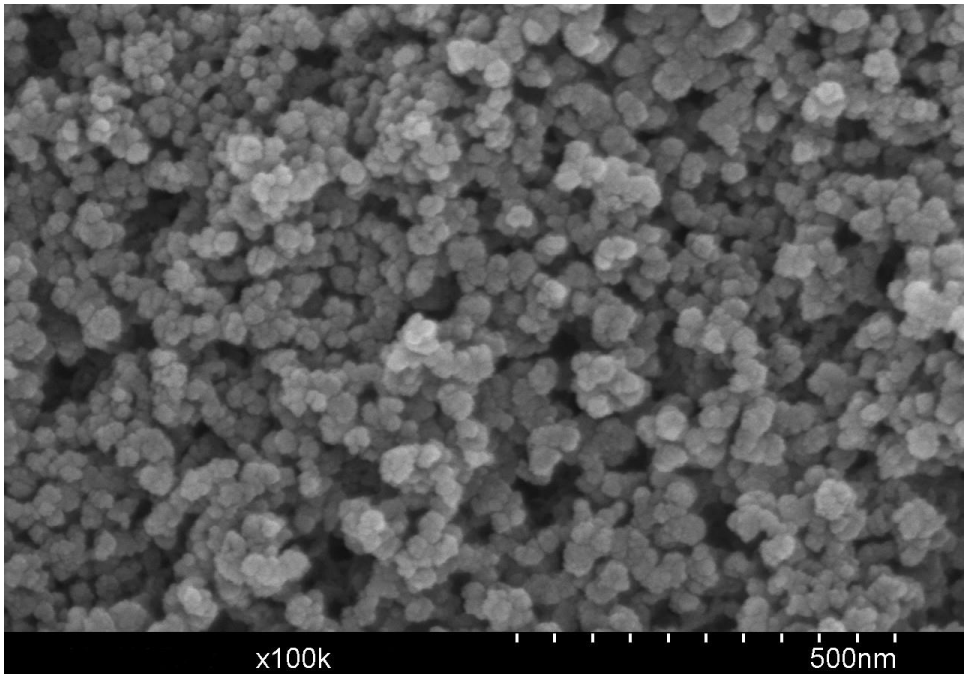



The characteristic powder x-ray diffraction (*40 kV, 30 mA, 0.02 steps, 2 seconds at each step*) chart of the ACP powders is shown above, this is how and why such powders are named as "x-ray amorphous."



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




The scanning electron microscope (*SEM*) photomicrographs show that the amorphous calcium phosphate (*ACP*) powders are comprised of approximately 50 nm (*nanometer*) particles. This average particle size perfectly coincides with that of the nanoparticles of the inorganic portion of the human bones and teeth's dentin. This is how such powders deserve the name "biomimetic."