

New Ways of Crystallizing Calcium Phosphates

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From fertilizers and food preservatives, across pharmaceuticals and cosmetics to ceramics and metallurgy there is one element linking all these diverse fields; phosphorus. Phosphorus in nature is mainly present as minerals belonging to the apatite group and is often found as collophane, francolite, and dahllite which are mined as rock-phosphate for example from igneous rocks.^[1] However, phosphorus is also essential to all forms of life. Almost every living being can form mineral phases in a process called biomineralization. Biominerals play a crucial role in the hardening and stiffing process of tissue, which in turn increases the mechanical resilience and therefore enables life as we know it.^[2] A broad variety of biochemical and physical processes can be involved in the formation of biominerals. By taking control over the crystallization of these biominerals, better insights into the formation process of biominerals can be achieved. Light-induced techniques are exceptionally suited for this approach as they offer an unmatched spatial and temporal resolution. However, light-induced crystallization of apatites has not been investigated so far. Here, I want to present a new way of precipitating hydroxyapatite by irradiation. A photolabile molecule (4-nitrophenylphosphate) is releasing phosphoric acid in aqueous solution exclusively after irradiation. Subsequent combination with calcium ions in the crystallization medium leads to the precipitation of carbonate hydroxyapatite which was fully characterized. Further, control over the localization and stabilization of the precipitate is achieved by using a pulsed laser, triggering the carbonate hydroxyapatite formation inside an agarose-sucrose gel, more closely mirroring the biological process in organic tissue. We anticipate, that this new way of apatite mineralization can lead to new applications of synthetic biominerals, for example as bone- or tooth replacement materials or as implants. Our findings might also contribute to other fields in science, such as chemistry for more elaborated reaction control.

[1] Structure and Chemistry of the Apatites and Other Calcium Orthophosphates, Vol. 18, 2 ed., Elliott (1994), *Elsevier Science*.

[2] Dorozhkin & Epple (2002), *Angewandte Chemie International Edition* 41, 3130-3146.

