

LETTER

Observation of nano-clustered calcite growth via a transient phase mediated by organic polyanions: A close match for biomineralization

INGO SETHMANN,^{1,*} ANDREW PUTNIS,¹ OLAF GRASSMANN,^{2,†} PEER LÖBMANN^{2,‡}

¹Institut für Mineralogie, Universität Münster, Corrensstraße 24, D-48149 Münster, Germany

²Lehrstuhl für Silicatchemie, Universität Würzburg, Röntgenring 11, D-97070 Würzburg, Germany

ABSTRACT

We present a process of organic polyanion-mediated CaCO₃ precipitation similar to biomineralization. Detailed insight into the formation pathway of nano-structured calcite crystals was gained through direct observation with an atomic force microscope (AFM). Essentially depending on a minimum saturation state, a primarily precipitated gelatinous film of polyaspartate calcifies as a transient, apparently amorphous phase, which gradually crystallizes as a calcitic single-crystalline nano-cluster of semicoherent domains. The similarity of this precipitation mechanism with that of biominerals and a striking consistency of materials properties of the synthetic precipitate with sea urchin calcite, investigated as a prime example of biomineralization, qualify our experiment as a functional model of biomineralization. The substantial role of water-soluble organic polyanions in biomineralization is elucidated.