

the crystal diameter increases into c-axis direction. In contrast, when the electric power applied to the a-axis of crystal is stronger than the electric power applied to c-axis of crystal, the crystal diameter increases into the a-axis direction. As a conclusion, to get the round shape crystal, the electric power of the lamp applied into a-axis direction of crystal should be stronger than c-axis direction of crystal.

Keywords: crystal growth, float zone growth, vanadium compounds

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Chiral and achiral mechanisms of regulation of calcite crystallization

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The regulation of calcite mineralization by chiral biological molecules is one of the fundamental unresolved issues at the interface between biological, geological, and physical sciences. Here we address the role of chirality of L-aspartic acid (L-Asp), a model additive, in the regulation of the calcite growth. We apply phase-shift interferometry to non-intrusively monitor *in situ* the morphology of the surface and quantify the velocity of propagation of the steps, during crystallization. Similar to complex behavior observed before, L-Asp leads to several-fold increase in the step velocity, in all directions, at low supersaturations, and several-fold slow down at high supersaturations. L-Asp also introduces asymmetry in the velocity of steps of related by mirror symmetry, however, of less than 10 %. To explain the complex effects of L-Asp, and, likely, of other biological regulators of calcite crystallization, we show that prior to incorporation into steps, calcium and carbonate ions adsorb on the terraces and diffuse towards the steps. L-Asp accelerates the surface diffusion towards the steps, an achiral process, likely due to re-arrangement by L-Asp of the structure of the water coating the calcite crystal surface. Importantly, L-Asp delays by about 20 times the incorporation of calcite ions into the steps, the only chiral process in the calcite crystallization mechanism, likely by blocking a significant fraction of the kinks. We show that the low asymmetry between the two chiral directions due to attenuation by the surface supply fields of the steps. The results and analyses presented here suggest that the chiral effects of bio-generated molecules on crystallization may be too weak to judge about biological or non-biological origin of minerals.

Keywords: chirality, calcite, *in-situ* observation

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Formation of barred olivine texture 4.6 billion years ago

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Most of chondritic meteorites falling onto the Earth contain mm-sized crystalline silicate spheres (chondrules), which are believed to have been formed from molten silicate droplets 4.6 billion years ago in our early solar system. Some of them have interesting textures with rim and bars. The rim has a thin shell-like morphology surrounding a chondrule. The bars are planar crystals parallel each other observed inside the rim. The remarkable features are that the rim connects with bars and the crystal orientation of the rim is the same as adjoining bars. Such texture has not been reproduced in the laboratory experiments except a few examples, therefore, the formation mechanism is unclear. We notice that the Mullins-Sekerka instability at the interface between the previously formed rim and the inside melt results into the formation of bars based on the linear stability analysis of Mullins and Sekerka (1964, *J. Appl. Phys.* 35, 444). We numerically simulate the crystallization of a supercooled silicate droplet by using a phase-field model. For simplicity, we consider a droplet of one component in our model, so we solve the equations for evolution of phase and temperature fields, but do not the equation of concentration. Initially, we assume that the rim is formed at the droplet surface. Since the rim is heated up to about the melting temperature by the release of the latent heat of crystallization, the temperature gradient from the hotter rim to the cooler inside is generated. In this situation, the interface between the rim and the inside melt is unstable during the solidification. Our simulation shows that the instability grows nonlinearly and parallel planar crystals are formed. This morphology is very similar to that observed in some natural samples of chondrules.

Keywords: crystal growth of silicates, supercooling, instability

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Property and morphology of organic modified CeO₂ nanocrystals synthesized in supercritical water

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We proposed a new method to synthesize organic-inorganic hybrid nanoparticles at supercritical hydrothermal conditions. By introducing organic legands (aminoacids, carboxylic acids, amines, alcohols, aldehydes etc.) into supercritical hydrothermal synthesis atmosphere, organic -inorganic hybrid nanocrystals are synthesized. For the case of CeO₂ nanocrystals, nanocubes with 100 surface could be synthesized. It is the first report that CeO₂ nanocrystals with 100 surface that has extremely high catalytic reactivity can be synthesized. With increasing the amount of surface modifier, shape of the nanocrystals was changed to truncated octahedron with 100