Abstract
In recent years, increasing evidence was reported that crystallization from solution does not exclusively follow the classical pathway of atom/ion/molecule mediated layer wise growth of a critical crystal nucleus. This was triggered by the discovery of amorphous or even liquid precursors to single crystals in Biomineralization and additive controlled crystallization events. Particle mediated crystallization pathways were found to be important besides the classical crystallization path. As all these reaction channels can lead to a single crystal end product, it is often difficult to reveal how this single crystal has formed.
In this presentation, examples will be given for stable prenucleation CaCO$_3$ clusters, which can already be found prior to nucleation. Nucleation of the subsequent amorphous phase seems to be triggered by cluster aggregation. Finally, crystals are formed. Crystallization in classical and nonclassical (particle mediated) crystallization can therefore be controlled at various reaction levels by polymer additives. These additives can already have an influence on the crystallization reaction before nucleation has taken place. The reaction path diversifies into classical and nonclassical crystallization after nucleation and consequently the possibilities to modify crystal growth by additives. The role of amorphous and liquid precursor particles and oriented aggregation and mesocrystal formation will be discussed highlighting the importance of such reaction channels in Biomineralization but also for crystallization as such.

Sea urchin spine – A biological mesocrystal with spongy structure on the micron scale