



Transformation of Amorphous Calcium Carbonate in Air - The Role of Additives and Humidity

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Amorphous calcium carbonate (ACC) is one of the six well-known $\text{CaCO}_3 \cdot n\text{H}_2\text{O}$ ($0 \leq n \leq 6$) solids and is of vast interest in the development of advanced materials. ACC offers enhanced performance compared to its crystalline equivalents due to its high solubility, specific surface and porosity. A large body of studies has been devoted to the applicability of ACC in pharmaceutical and industrial domains, pointing out material porosity to be a key property for its application. However, less is known about the material porosity evolution during ACC transformation into crystalline calcium carbonate (e.g. calcite or vaterite).

In this study we investigate the transformation of ACC in air and the effect of three additives (magnesium chloride, activated carbon and xanthan) at distinct humidities on the properties of the final crystalline product. ACC standard material was synthesized in either pure form or together with one of the above additives, stamped into a pellet, and exposed to 40 or 75 % RH. Mineralogical characterization of the crystalline products exhibits individual quantitative polymorph distribution induced by different additives and humidities. The most prominent result of the present study is the highly dissimilar pore size distribution when the ACC pellets were exposed to different humidities. Scanning electron microscopy combined with an image analysis software revealed 75 % RH to cause an increase of pore size of the final product by a factor of 10. These findings have significant implications to tailor and improve ACC nanomaterial designs and syntheses for pharmaceutical and industrial applications.