Microscopic study of the thermal dehydration reaction of $Li_2SO_4.H_2O$ monocrystals

Introduction

Thermochemical heat storage has been recognized as a promising techinique to solve the mismatch of superfluous solar energy in summer and large heating demand in winter. Research on thermochemical materials(TCM) has attacted more and more attention gloablly. Compared to sensible and phase change materials, TCM usually have high energy density, which is critical for the design of a compact system in the domestic applications. Moreover, energy stored in TCM is deposited in physical or chemical bonds. They are stable and have less loss, in particular, for the seasonal heat storage. Besides, a large group of candidates like salt hydrates are cheap and non-toxic.

Problem description

There are several issues to be taken into account (e.g. the kinetics of the reaction, mass transfer, heat transfer) before a thermochemical storage system can be realized succesfully. In this work, lithium sulphate monohydrate is chosen as a model material and the kinetics of the reaction will be studied. It has been found that many dehydration reactions of salt hydrates occur in the form of nucleation and nuclei growth processes. Therefore, a heating stage micscopy system is developed to observe nucleation and growth processes directly. For the surface observations, a single crystal of of $Li_2SO_4.H_2O$ is placed at the reactor where the temperature and water vapor pressure are controlled during the dehydration reaction. The optical microscopy will be applied to observe the reaction under certain temperature and pressure.

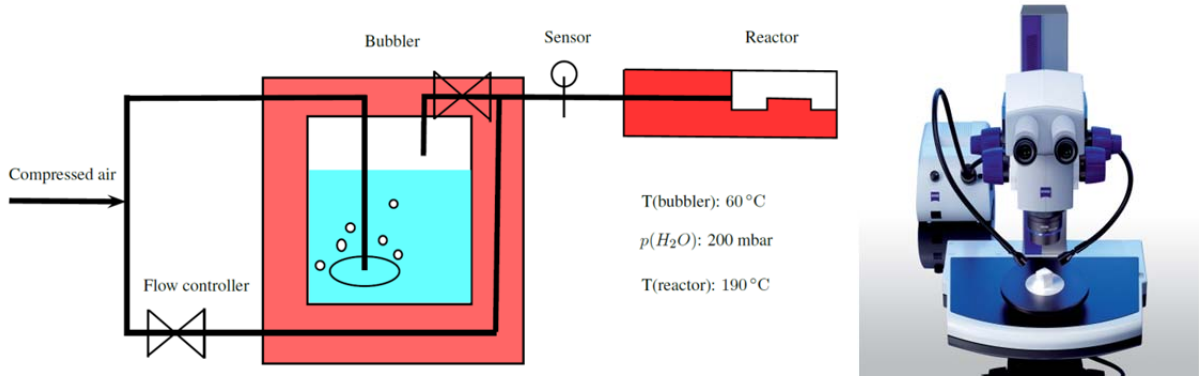

Figure 1. Temperature and water vapor pressure controlled reactor (left) and SteREO microscope (right).

Assignments

- Test the system with both temperature and water vapor pressure controlled.
- Perform experiments at certain temperature and various water vapor pressures.
- Analyse the results and write a report.

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