Glass transition temperatures and crystallization kinetics of a synthetic, anhydrous, amorphous calcium-magnesium carbonate

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We report the first calorimetric observations of glass transition temperatures and crystallization rates of anhydrous, amorphous calcium-magnesium carbonate using fast scanning differential scanning calorimetry (FDSC). The hydrous amorphous $Ca_{0.95}Mg_{0.05}CO_3 \cdot 0.5H_2O$ (ACMC05) solid was precipitated from a $MgCl_2$–$NaHCO_3$ buffered solution, separated from the supernatant, and freeze-dried. Part of the freeze-dried samples were additionally dried at 250 °C for up to 6 hours in a furnace in a high purity nitrogen atmosphere to produce anhydrous ACMC. The limiting fictive temperature of the anhydrous $Ca_{0.95}Mg_{0.05}CO_3$ was determined (by applying different heating rates (2000-6000 K/s, see Fig. 1) and correcting for thermal lag) to be 376 °C and the intensity of the glass transition or relaxational heat capacity is $\Delta Cp = 0.16$ J/(g K). Additionally, the heating rate dependence of the peak temperature of the corrected crystallization peaks is used to determine the activation energy of crystallization to be 275 kJ/mol. A high-resolution transmission electron microscopy study has been performed on the hydrous and anhydrous samples to provide further characterization of their compositional and structural states.

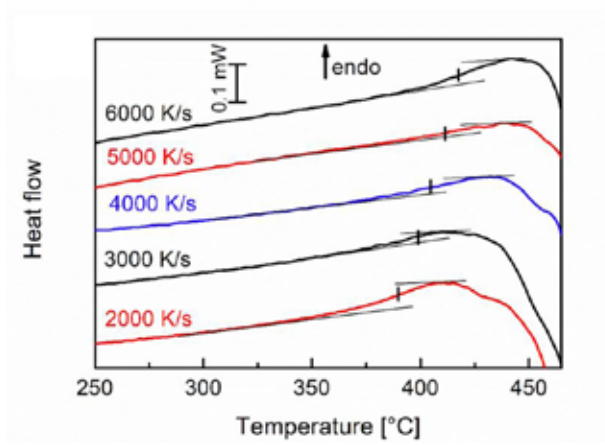

Figure 1. Heat flow curves of ACMC05.