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Analysis of chemical reaction between Li_4SiO_4 and CO_2 by thermogravimetry under various CO_2 partial pressures – Clarification of CO_2 partial pressure and temperature region of CO_2 absorption or desorption.

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Chemical reaction between CO_2 and Li_4SiO_4 was investigated using thermogravimetry under various $P(CO_2)$. Under $P(CO_2)$ of 1.0 bar, weight increase originating from CO_2 absorption reaction was observed from ~500 ºC and abrupt weight reduction due to CO_2 desorption was detected at ~700 ºC. With decreasing $P(CO_2)$, the latter temperature decreased. Since fair agreement was observed between the latter temperatures and thermodynamically calculated equilibrium temperatures of $Li_4SiO_4+CO_2 \leftrightarrow Li_2CO_3+Li_2SiO_3$, the latter temperatures could be regarded as approximate equilibrium. Dependence of the calculated equilibrium temperatures and approximate equilibrium temperatures on $P(CO_2)$ was represented with Ellingham diagram, showing $P(CO_2)$ and temperature region of CO_2 absorption or desorption. Approximate equilibrium temperature under $P(CO_2)$ of 1.0 bar agreed with the calculation, whereas deviation was observed under low $P(CO_2)$, resulted in larger apparent $\Delta S°$ and $\Delta H°$ than the calculated ones. Using specimen with smaller particle size, the deviation reduced due to enhancement of CO_2 desorption kinetics.

Graphical Abstract

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