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The hydrothermal conversion of kaolinite to kalsilite: Influence of time, temperature, and pH

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Abstract

Kalsilite (the low-temperature form of $KAlSiO_4$) is used as the precursor of leucite, an important component in porcelain-fused-to-metal and ceramic-restoration systems, and it has also been proposed as a high-thermal expansion ceramic for bonding to metals. The present study reports the hydrothermal synthesis and characterization of pure kalsilite from kaolinite in subcritical conditions, as well as the characterization of the intermediate products by means of XRD, ^{29}Si and ^{27}Al MAS NMR, IR, SEM, and TEM. Effects of time, temperature, and pH on the reaction products are analyzed. The experimental data indicate that pure kalsilite is obtained after hydrothermal treatment of kaolinite at 300 °C for 12 h in 0.5 *M* KOH solution. Longer reaction times increase the crystallinity of the structure, whereas lower reaction times give rise to the metastable ABW-type $KAlSiO_4$ polymorph. Lower temperatures are not sufficient to produce kalsilite, but zeolite W is obtained instead as the unique reaction product. Finally, the pH of the aqueous solution in contact with kaolinite is an important parameter for the synthesis of kalsilite, which must be ≥13.70.

Keywords: Kalsilite, kaolinite, hydrothermal synthesis, MAS NMR, XRD