

---

# Effects of Solution Chemistry on the Hydrothermal Synthesis of Kaolinite

Ritsuro Miyawaki<sup>1</sup>, Shinji Tomura<sup>1</sup>, Soichiro Samejima<sup>3, \*</sup>, Masaharu Okazaki<sup>2</sup>,  
Hiroyuki Mizuta<sup>1</sup>, Shin-ichi Maruyama<sup>3</sup> and Yasuo Shibasaki<sup>1</sup>

<sup>1</sup> Ceramic Technology Department, Government Industrial Research Institute, Nagoya, Kita, Nagoya 462, Japan

<sup>2</sup> Radiation Research Department, Government Industrial Research Institute, Nagoya, Kita, Nagoya 462, Japan

<sup>3</sup> Engineering Research Association for Artificial Clay, Government Industrial Research Institute, Nagoya, Kita, Nagoya 462, Japan

\*Present address: Chemical Research Laboratory, TOSOH Corporation, Shin Nan-yo, Yamaguchi 746, Japan.

**Abstract:** The hydrothermal synthesis of kaolinite was examined in the  $\text{Al}_2\text{O}_3\text{-SiO}_2\text{-H}_2\text{O}$  system to study inhibitory effects of additional ions on the formation of kaolinite. Syntheses were carried out with amorphous starting materials and salt solutions of various concentrations in Teflon pressure vessels at 220°C for 5 days. The reaction products were characterized by XRD, IR, DTA-TG, NMR and TEM. In all of the runs using solutions with cation concentrations less than 0.001 M, no significant effect on the formation of kaolinite was observed. The inhibitory effect of the univalent cations  $\text{Li}^+$ ,  $\text{Na}^+$  or  $\text{K}^+$  was less than that of divalent cations such as  $\text{Mg}^{2+}$  or  $\text{Ca}^{2+}$ . The addition of trivalent  $\text{Fe}^{3+}$  or excess  $\text{Al}^{3+}$  ions interfered with the formation of kaolinite significantly. Sulfate and acetate solutions interfered with the formation of kaolinite more than chlorides and nitrates. No crystalline product was obtained using a 1.0 M basic solution of carbonate or hydroxide. The addition of the lithium ion to the system affected the crystallization of kaolinite only slightly. The use of 0.1 M  $\text{LiCl}$  and  $\text{LiNO}_3$  solutions for the syntheses improved crystallization of kaolinite along the [001] direction.

**Key Words:** Effect of ions • Hydrothermal synthesis • Kaolinite • Solution chemistry

*Clays and Clay Minerals*; October 1991 v. 39; no. 5; p. 498-508; DOI:

[10.1346/CCMN.1991.0390505](https://doi.org/10.1346/CCMN.1991.0390505)

© 1991, The Clay Minerals Society

Clay Minerals Society ([www.clays.org](http://www.clays.org))

---