

SHORT COMMUNICATIONS

Formation of Mullite from Kaolin Minerals at Low Temperature

By Hiroshi OKUDA

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Mechanism of the mullite formation has not been explained completely, and there is a widespread disagreement concerning the formation temperature in the literatures¹⁻⁴. It was reported that the formation of mullite from well-crystallized kaolinite occurs above 950°C and the formation of mullite from poorly crystallized kaolinite and halloysite occurs at a higher temperature^{5,6}. Colegrave and Rigby⁷ showed that traces of mullite were formed, when kaolinite was mixed with 2% of boric oxide and heated at 900°C. for 200 hr. No literature reported that the formation of mullite from kaolin minerals occurred below 900°C.

During the course of an investigation of the effects of additive on the mullite formation of kaolin minerals⁸, it was found that fluoride of

alkali and alkaline earth elements promoted the formation and lithium fluoride was most effective. The present experiment has been carried out to find the effect of additive lithium fluoride on the temperature of mullite formation.

A well-crystallized kaolinite from Kampaku, Tochigi Prefecture, Japan and halloysite from Korea were used. The dried minerals were mixed with 2.5, 5 and 10% of lithium fluoride. The mixtures were heated for 5 hr. at 500, 550, 600, 700, 800 and 900°C. The heated samples were examined by an X-ray diffractometer, and the results are shown in Fig. 1 and Table I.

When 2.5% of lithium fluoride was added to kaolin, mullite and β -spodumene started to be formed at 800°C. The kaolin mixed with 5% of lithium fluoride was converted into β -spodumene above 600°C and into mullite above 700°C. It was found that β -spodumene was formed at 500°C and a small amount of mullite was formed at 550°C, when kaolin was mixed with 10% of lithium fluoride.

It is concluded that by the addition of lithium fluoride the kaolin minerals form mullite at a extremely lower temperature than that reported in the literature. Further experiment, however,

TABLE I. PHASE FOR KAOLIN MINERALS CONTAINING LITHIUM FLUORIDE HEATED AT VARIOUS TEMPERATURES FOR 5 HR.

Sample	Temp. (°C)					
	500	550	600	700	800	900
Halloysite +2.5% LiF	halloysite	metakaolin	metakaolin	metakaolin	β -sp. mull.	β -sp. mull.
Halloysite +5% LiF	halloysite	metakaolin	β -sp.	β -sp. mull.	β -sp. mull.	β -sp. mull.
Halloysite +10% LiF	halloysite β -sp.	β -sp. mull.	β -sp. mull.	β -sp. mull.	β -sp. mull.	β -sp. mull.
Kaolinite +2.5% LiF	kaolinite	metakaolin	metakaolin	metakaolin	β -sp. mull.	β -sp. mull.
Kaolinite +5% LiF	kaolinite	metakaolin	β -sp.	β -sp. mull.	β -sp. mull.	β -sp. mull.
Kaolinite +10% LiF	kaolinite β -sp.	β -sp. mull.	β -sp. mull.	β -sp. mull.	β -sp. mull.	β -sp. mull.

β -sp. : β -spodumene, mull. : mullite

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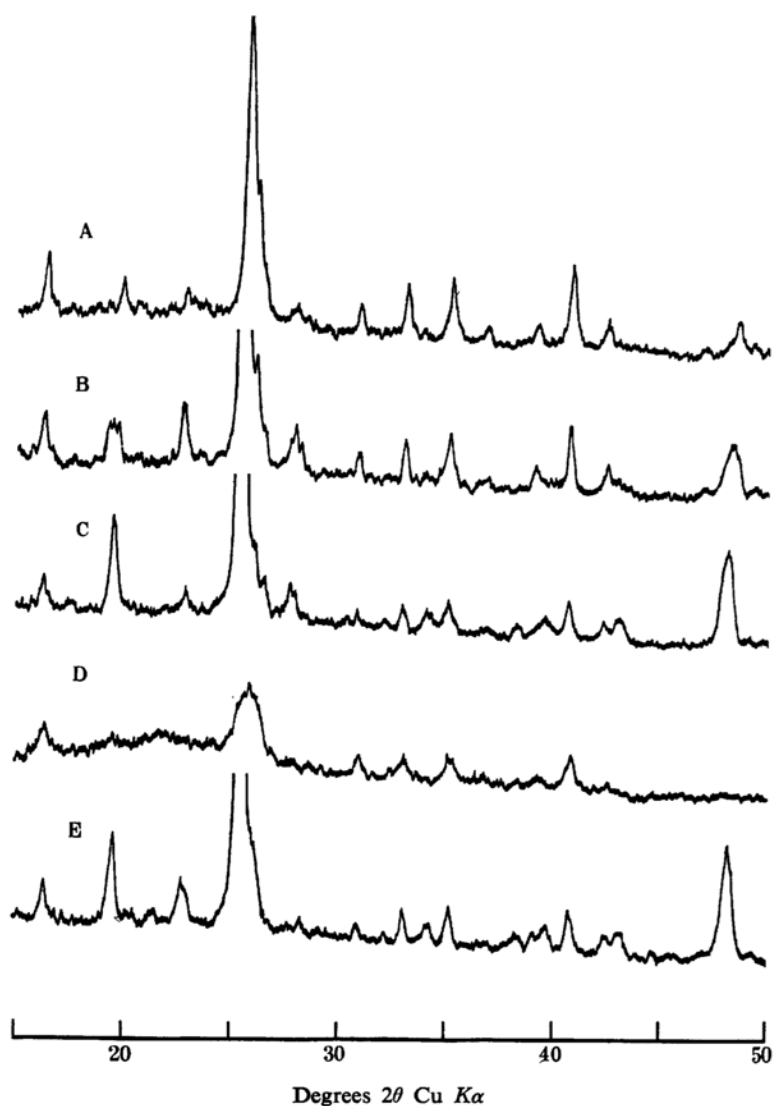


Fig. 1. X-ray diffraction patterns of kaolin minerals containing lithium fluoride. A, is for the mixture of halloysite and 2.5% LiF heated at 800°C: B, the mixture of halloysite and 5% LiF heated at 700°C: C, the mixture of halloysite and 10% LiF heated at 550°C: D, the mixture of kaolinite and 2.5% LiF heated at 800°C: and E, the mixture of kaolinite and 10% LiF heated at 550°C. Heating period is 5 hr. in all cases.

is necessary to understand the mechanism of the mullite formation and to explain the effect of the addition of lithium fluoride on the formation.

*Government Industrial
Research Institute
Kita-ku, Nagoya*