

알루미나에서 스피넬상의 불연속 용해
(Discontinuous Dissolution of Iron Aluminate Spinel
in the $\text{Al}_2\text{O}_3\text{-Fe}_2\text{O}_3$ System)

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INTRODUCTION :

In the present investigation a possibility of discontinuous dissolution (DD) is explored in Al_2O_3 . According to the quasibinary temperature-composition diagram of the $\text{FeO-Fe}_2\text{O}_3\text{-Al}_2\text{O}_3$ system in air (Figure 1) two-phase mixture of corundum and iron aluminate spinel can become unstable and result in single corundum phase by temperature decrease for certain composition range. For example, when specimens of $85\text{Al}_2\text{O}_3\text{-}15\text{Fe}_2\text{O}_3$ (in wt%) are sintered in the two-phase region (indicated by "S") and subsequently quenched to lower temperature where the spinel phase is unstable (indicated by "H"), the spinel particles would dissolve into corundum grains and form new corundum solid solution containing higher Fe_2O_3 . During the process, the grain boundary diffusion of Fe_2O_3 from the dissolving particles is expected to induce the grain boundary migration.

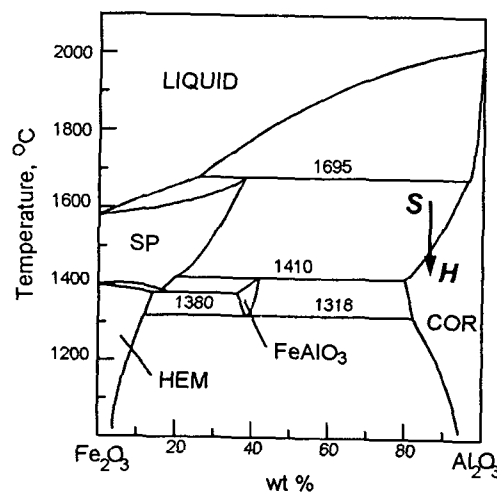


Fig. 1. Quasibinary phase diagram of the $\text{FeO-Fe}_2\text{O}_3\text{-Al}_2\text{O}_3$ system in air.

COR: Corundum; HEM: Hematite; and SP: Spinel.

EXPERIMENTAL PROCEDURE :

Powder mixtures of 85Al₂O₃-15Fe₂O₃ (in wt%) were wet-milled for 12 h in alcohol and the dried slurry was isostatically pressed under 200 MPa into disks of 15 mm diameter and 10 mm height. Packed in powders of the same composition in order to reduce the volatilization of Fe₂O₃ from the compacts, the compacts were sintered at 1600°C for 10 h in air and quenched to room temperature. All sintered specimens were cut, ground, polished, and then annealed at 1450°C for various times between 10 min and 70 h in air without packing powder. Microstructural observations were made on the polished sections of sintered and annealed specimens without further treatment. In the sintered and annealed specimens the phases present were identified by X-ray diffraction (XRD) with Cu K α and their cation compositions were determined by wavelength dispersive spectroscopy (WDS).

EXPERIMENTAL RESULTS :

When sintered 85Al₂O₃-15Fe₂O₃ (in wt%) specimens constituting of corundum grains and spinel particles were annealed at temperature where only a corundum phase was stable, the phase transformation of spinel into metastable FeAlO₃, a compositional intermediate phase between spinel and corundum, and subsequently the complete dissolution and transformation of FeAlO₃ occurred concomitantly with the migration of grain boundaries at the surface of the specimens. Since the grain boundary migration was induced by grain boundary diffusion of Fe₂O₃ from the transforming and dissolving particles, the boundary migration by temperature decrease corresponds to a discontinuous dissolution of the spinel particles and a chemically induced grain boundary migration by temperature change. Inside the specimens, however, the transformation-dissolution and the grain boundary migration were suppressed because of unavailable accommodation of the volume expansion due to the transformation.