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Interfacial reaction between magnesia refractory and $FeO\text{-}SiO_2\text{-}MgO\text{-}MnO\text{-}Al_2O_3\text{-}Li_2O$ slag

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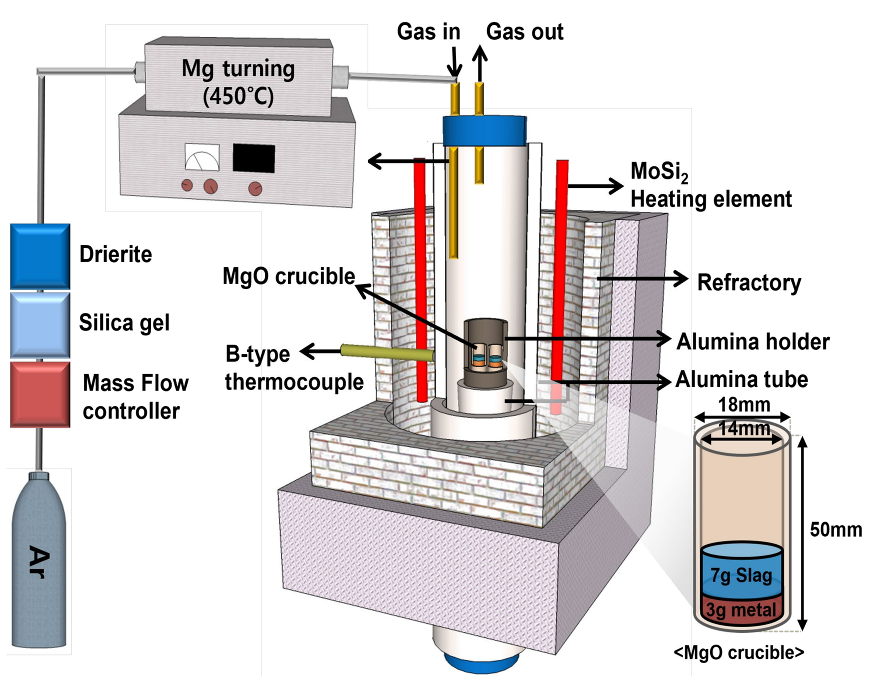
1 INTRODUCTION

In the pyrometallurgical recycling process, **magnesia-based refractory** is widely used due to its **excellent heat** and **corrosion resistant** against FeO-bearing slags. However, chemical and physical reactions occur at the slag-refractory interface, such as the **dissolution of the refractory**. As MgO dissolution progresses, the composition of the slag can change, leading to altered physicochemical properties that can affect slag penetration. Therefore, a fundamental understanding of the interfacial reactions between refractory and slag is necessary **to extend the service life of refractories**.

In the present study, the interfacial reaction between magnesia refractory and **$FeO\text{-}SiO_2\text{-}MgO\text{-}MnO\text{-}Al_2O_3\text{-}Li_2O$** multicomponent slag was investigated at 1823 K based on thermodynamic principle.

2 METHODS

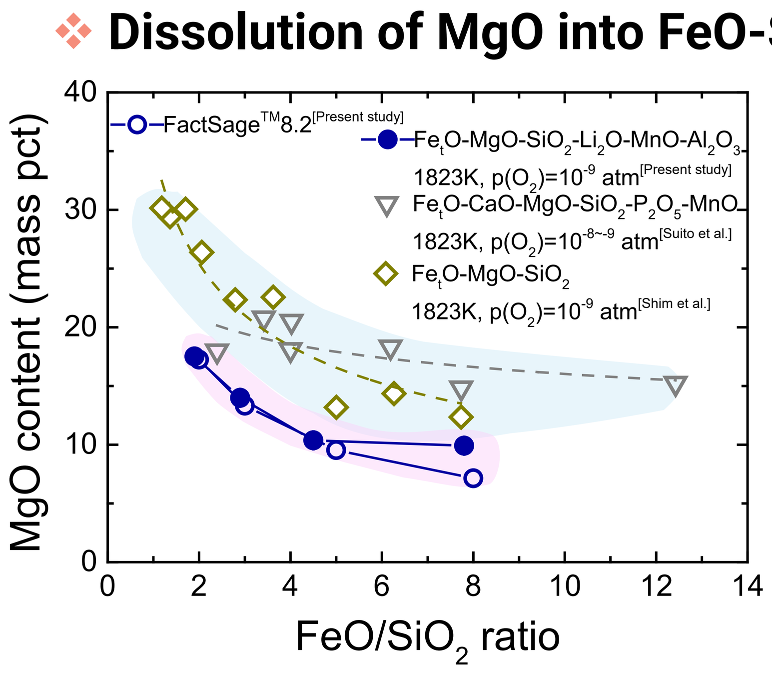


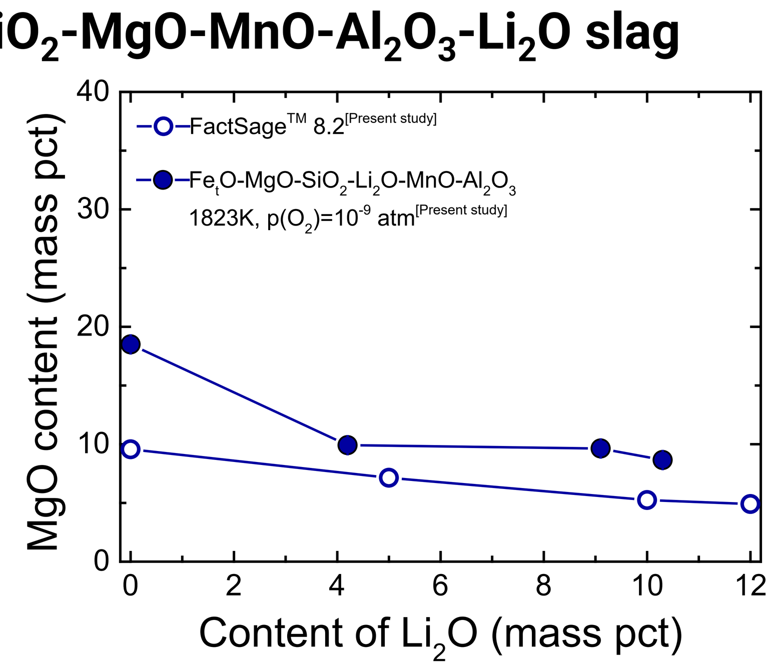
Super Kanthal Electric Resistance Furnace

- **Temperature** : 1823 K
- **$p(O_2)$** : 10^{-9} atm
- **Crucible** : MgO
- **Atmosphere** : Purified Ar
- **Slag** : $FeO\text{-}SiO_2\text{-}MgO\text{-}MnO\text{-}Al_2O_3\text{-}Li_2O$
- **Metal** : Fe-20Ni (wt%)
- **Equilibrium Time** : 24 hr
- **Analysis** : ICP-OES, SEM-EDS, XRD

3 RESULTS & DISCUSSION

Dissolution of MgO into $FeO\text{-}SiO_2\text{-}MgO\text{-}MnO\text{-}Al_2O_3\text{-}Li_2O$ slag





$$(FeO) = (Fe^{2+}) + (O^{2-})$$

$$a_{O^{2-}} = \frac{K \cdot a_{FeO}}{a_{Fe^{2+}}} = \frac{K \cdot \gamma_{FeO} \cdot X_{FeO}}{a_{Fe^{2+}}}$$

$$(Li_2O) = 2(Li^{+}) + (O^{2-})$$

$$a_{O^{2-}} = \frac{K \cdot a_{Li_2O}}{a_{Li^{+}}} = \frac{K \cdot \gamma_{Li_2O} \cdot X_{Li_2O}}{a_{Li^{+}}}$$

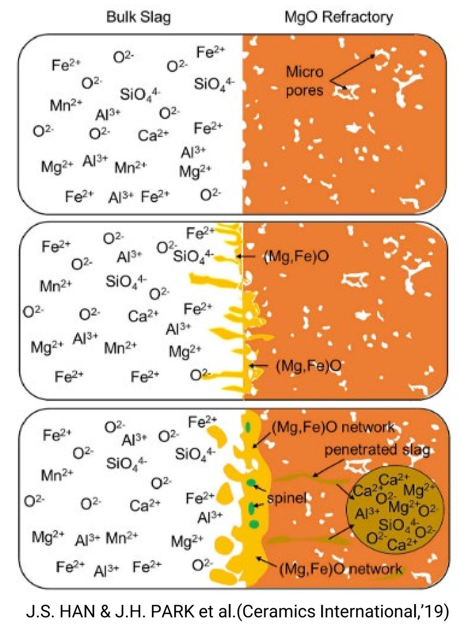
Formation of the Magnesiowüstite layer $(Mg,Fe)O_{solid\ solution}$

<MW layer formation Equation>

$$(FeO)_{slag} + MgO(s)_{refractory} = (Fe,Mg)O_{solid\ solution}$$

$$K = \frac{a_{(Fe,Mg)O_{solid\ solution}}}{a_{MgO_{refractory}} \cdot a_{FeO_{slag}}} \qquad K = const.$$

The formation of the Magnesiowüstite phase is influenced by the $a_{FeO_{slag}}$



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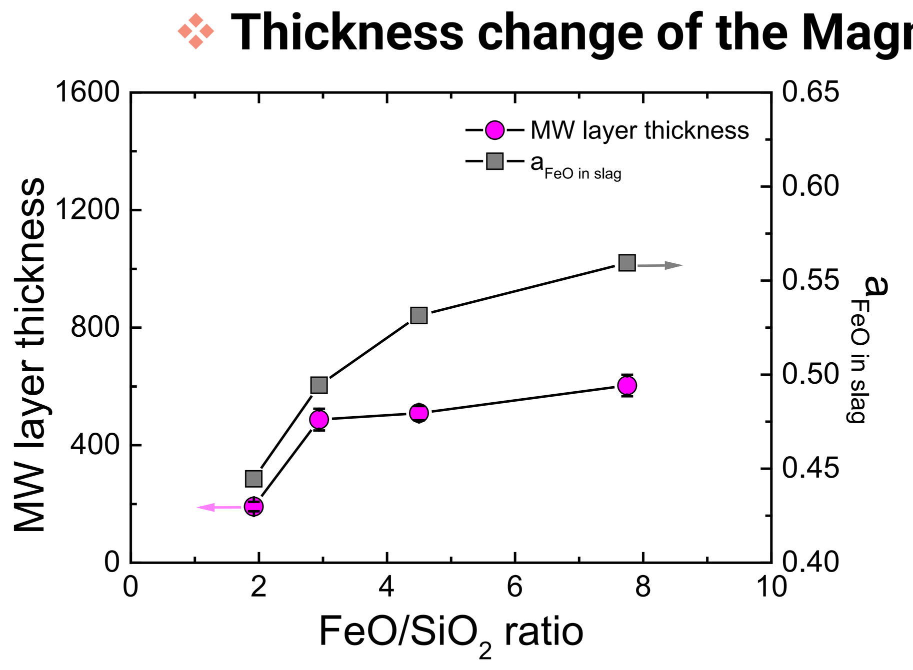
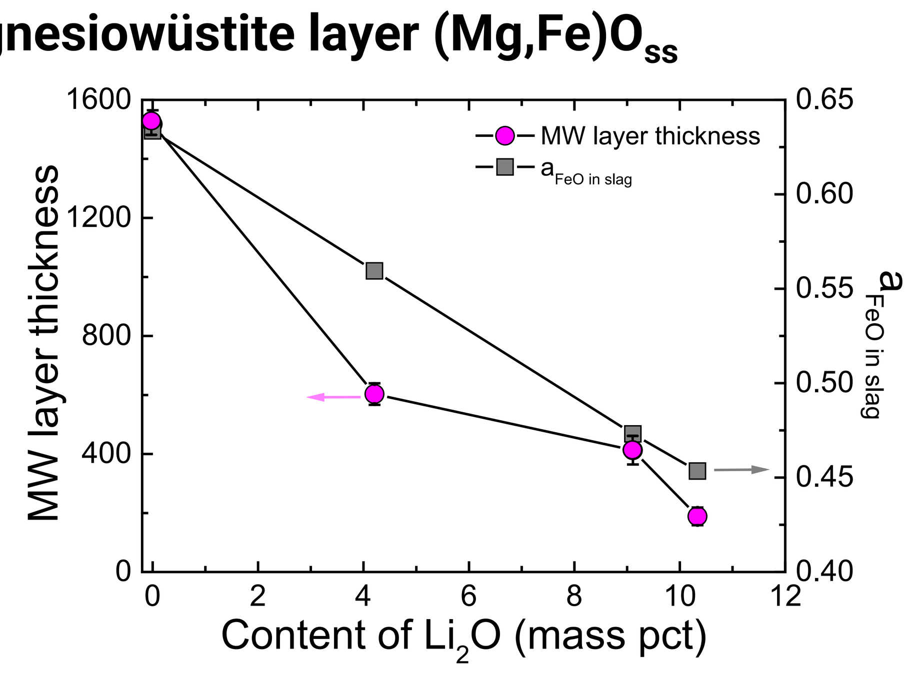
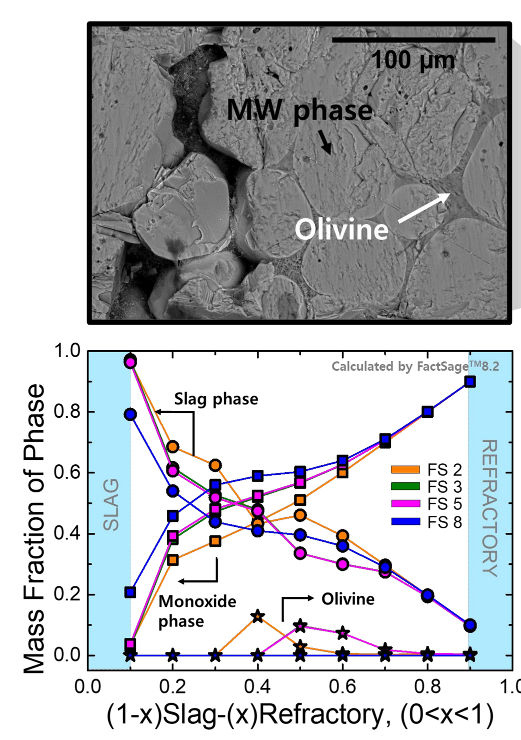
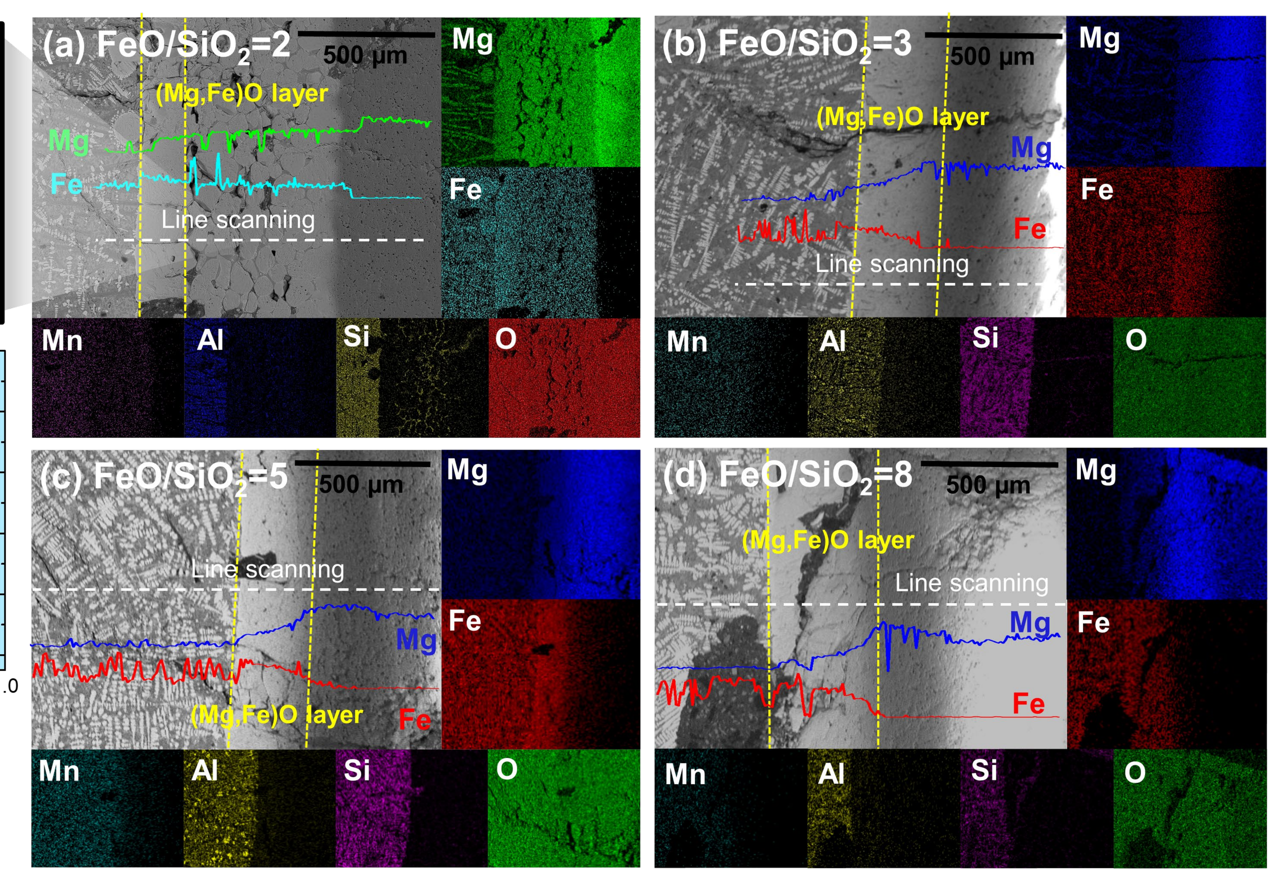
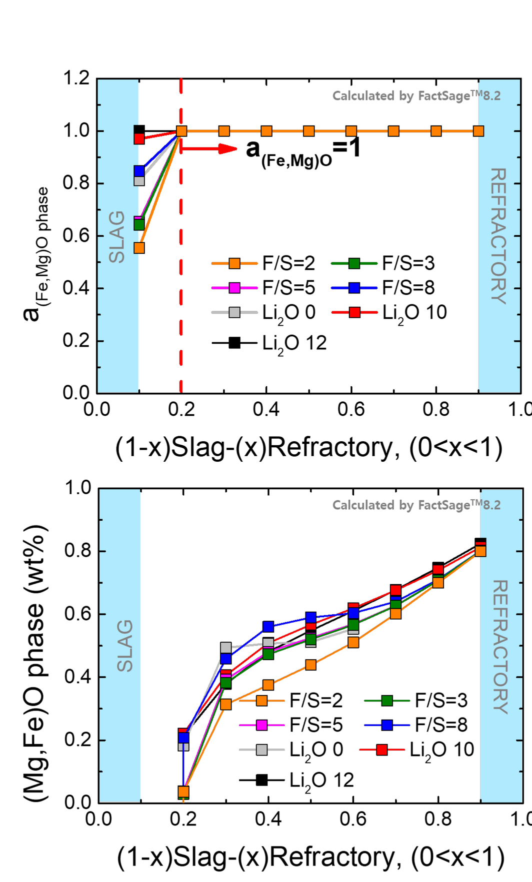
Thickness change of the Magnesiowüstite layer $(Mg,Fe)O_{ss}$

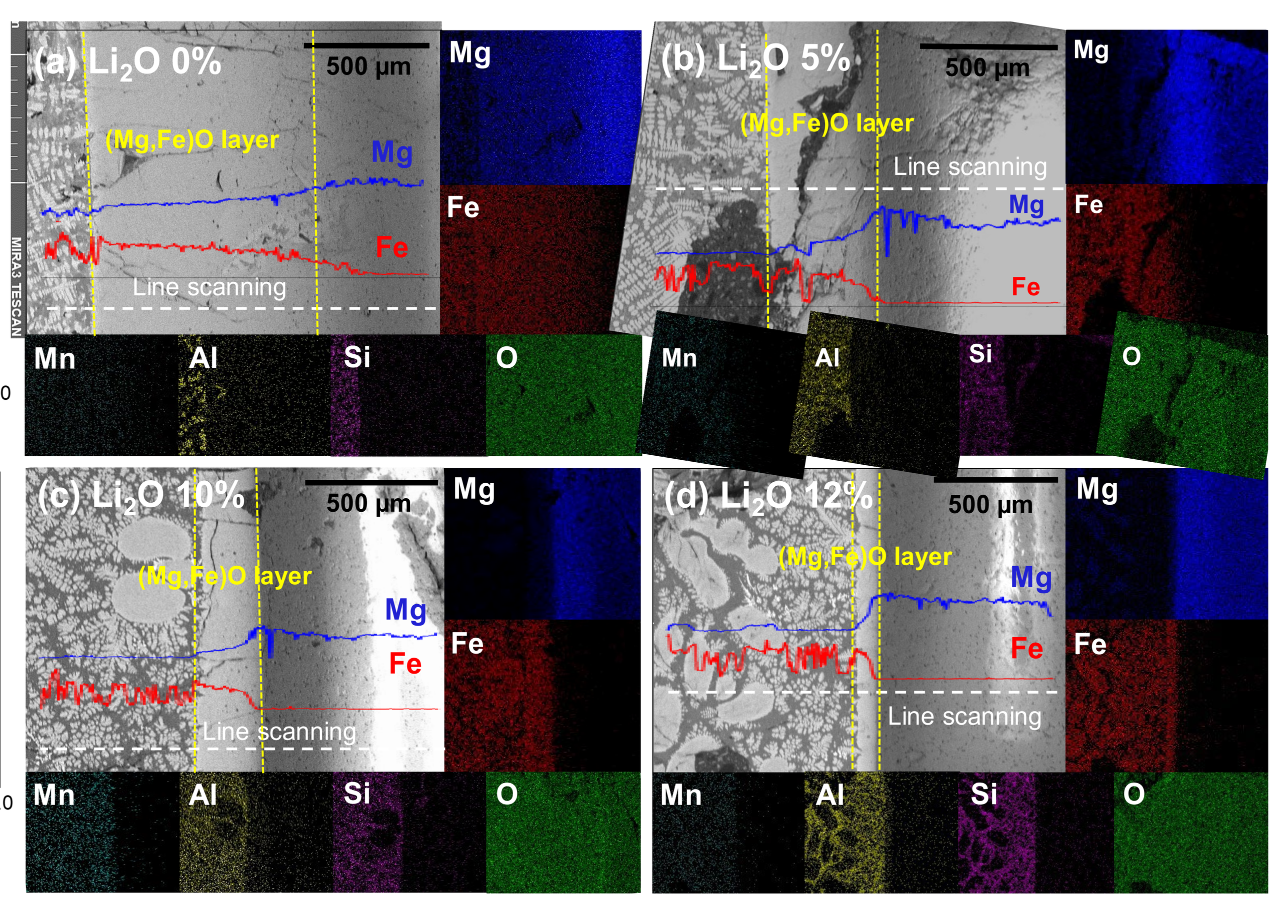












4 CONCLUSIONS

Interfacial reactions between MgO refractory and **$FeO\text{-}SiO_2\text{-}MgO\text{-}MnO\text{-}Al_2O_3\text{-}Li_2O$** slags were investigated at **1823 K, $p(O_2)=10^{-9}$ atm**.

1. By providing **free oxygen ions(O^{2-})**, MgO solubility was reduced due to the basic behavior of FeO and Li_2O, which **dissociate the slag structure.**
2. **Magnesiowüstite layer** was formed at the slag-refractory interface.
3. Generally, the thickness of the Magnesiowüstite layer changes **proportionally to the FeO activity in slag**. However, at an FeO/SiO_2 ratio=2, due to the lesser amount of added FeO, slag penetration occurs before the formation of a dense layer.

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