MORITA-YOSHIKAWA LAB.

[Materials Processing for Sustainable Society]

International Research Center for Sustainable Materials

http://wood2.iis.u-tokyo.ac.jp

Materials Production and Recycling Engineering Lab.

Dept. Materials Engineering

We consider elementary materials, such as steel and silicon, as recycling materials, and aim at the establishment of environment-friendly society by developing their production and recycling processes together with by-product treatment. Physico-chemical studies for *Innovation of Iron- and Steel-making*, *Solar-Grade-Silicon Refining Processes* and *Enrichment of Waste Materials* are being carried out in our laboratory with consideration on thermodynamics and high temperature physical properties.

Development of Novel Refining Process for Solar Grade Si

◆ **New concept refining by solidification**
– Low temperature purification using alloy solvent

New solidification
Si-Al(l) ⇒ Si(s)

General solidification
Si (l) ⇒ Si (s)

Al

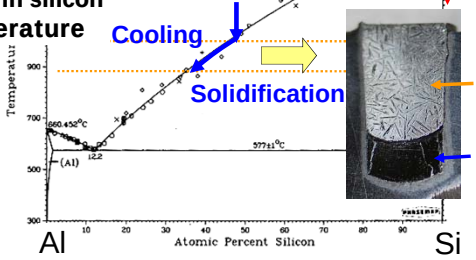
Si

Alloying Si with Al

To use the instability of impurities in silicon at low temperature

Cooling

Solidification



Si-Al melt

Purified Si
(~99.9995%)

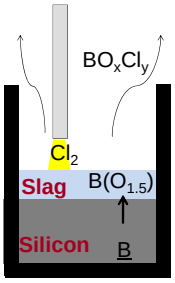
◆ **Purification by slag with gaseous chlorine**
– Vaporization of B through molten slag

- **Limit of B removal by single slag phase**
- **Affinity of B with chlorine**

To suppress silicon chlorination

⇒ Cl_2 supply through molten slag

$$B(l) + 1/2O_{2x}(g) + 1/2Cl_{2y}(g) \Rightarrow BO_xCl_y\ (g)$$



High Temperature Physical Chemistry of Iron- and Steel-making Processes

◆ **Thermodynamics of minor elements in solid and molten steel**

◆ **Slag chemistry – physico-chemical properties and structural analysis**

Target

- **Optimization of refining process**
- **Heat recovery from molten slag**

⇒ To construct the sustainable refining processes

Research contents

➢ **Thermodynamics study of molten slag**

➢ **Thermal conductivity of slag**
(Determination by hot wire method)

Gradual cooling of steelmaking slag

➢ **Solid-state NMR spectroscopy for analyzing slag structure**

Atomic-molecular levels understanding and control of thermodynamic and physico-chemical properties of slag

NMR instrument
(JEOL ECA-500)

^{11}B MAS-NMR spectrum in $CaO\text{-}SiO_2$ slag

Boron changes its structure from trigonal to tetrahedral coordination with oxygen