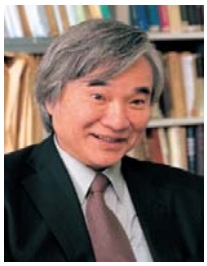

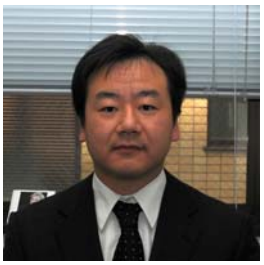

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Key Words: Microwave Ironmaking, Ferrous, Nonferrous, Slag, Glass, Physical properties

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Research Subjects and Objectives

We are developing environmentally friendly high temperature processes such as a new pig ironmaking process aiming at CO_2 emission reduction and energy conservation, and ferrous and nonferrous smeltings using abundant minerals with poor characters. We are also carrying out basic researches for developing new processes or revising current processes. For example, we are measuring thermophsical properties of liquid metals and oxides and thermodynamic properties of slags to interpret them from the structural viewpoints, and also observing nano-scale structures of solid surfaces by scanning tunneling microscopy (STM) to elucidate the gas adsorbing and reaction mechanisms. Our researches are based on equilibrium and non-equilibrium thermodynamics, transport phenomena, electron theory of metals and so on.

1. Development of continuous ironmaking using microwave - It takes only 15 minutes to produce pig iron from iron ore when you use a microwave oven!

Currently, CO_2 emission reduction and energy conservation are urgent tasks for prevention of global warming. Since large fraction of CO_2 emission is attributed to the blast furnace-type ironmaking in Japan in spite of the fact that Japanese blast furnace technology has been already advanced, new ironmaking process should be invented based on innovative theories and mechanisms. Heat source for blast furnace is high temperature gas produced by combustion of coak. If the heat source is substituted by microwave generated by electric sources such as wind powder, solar power and nuclear power, CO_2 emission associated with fossil fuels could be dramatically reduced. Therefore, we are developing a continuous ironmaking process by means of microwave. We are also carrying out the following fundamental researches; (i) iron ore reduction and carburization mechanisms for microwave heating using multi and single mode microwave furnaces and (ii) microwave absorbing mechanisms for solid materials by measuring electric permittivity and magnetic permeability at high temperatures.

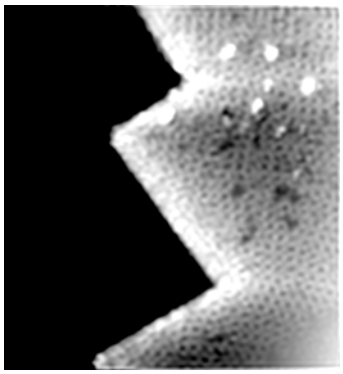

Fig.1 STM observation of Fe_xO single crystal.

Fig.2 Microwave furnace for ironmaking, which allows the raw materials to be irradiated by directional microwave.

2. Development of F free mould flux for continuous casting of steel

Although a massive amount of fluorine is harmful to humans, slags and fluxes containing CaF_2 are still used at steel making industries. We are developing fluorine-free fluxes for continuous casting of steel.

3 . Measurements of physico-chemical properties of liquid metals and oxides – It's important to go back to basics anytime for further advance!

We are measuring thermal conductivities, sound velocities and absorption coefficients of ultrasonic waves on liquid metals and oxides and thermodynamic activities of compounds for slags. We are interested in the relationship between structures and properties.