

# TOKORO LAB.

## [Resource Circulation, Separation-Concentration, Powder Processing]

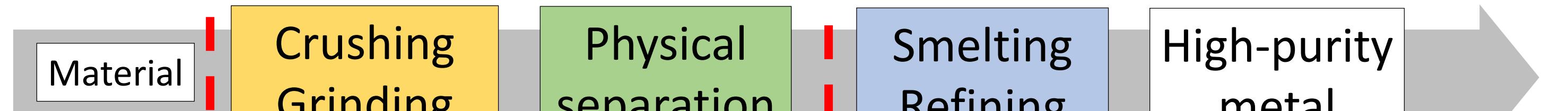
Endowed Research Unit for Non-ferrous Metal Resource Recovery Engineering  
(JX Metals Endowed Unit)

Environmental Resource Processing Engineering

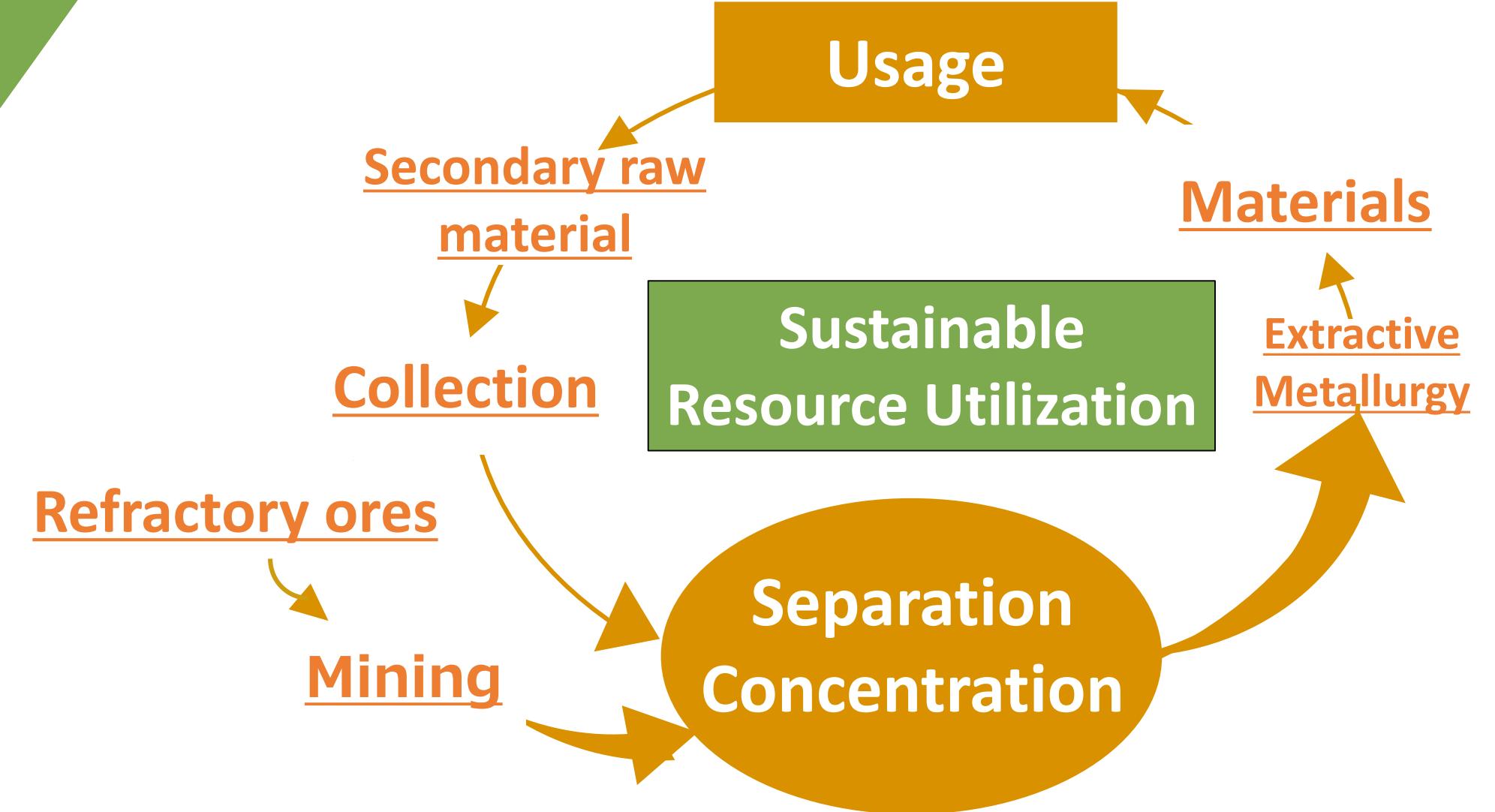
<http://www.metals-recycling.iis.u-tokyo.ac.jp/chiharutokoro.html>  
<http://www.tokoro.env.waseda.ac.jp/>

### Technologies for resource circulation / environmental restoration

Valorization of urban mine resources and refractory ores by advanced technologies for solid separation and concentration

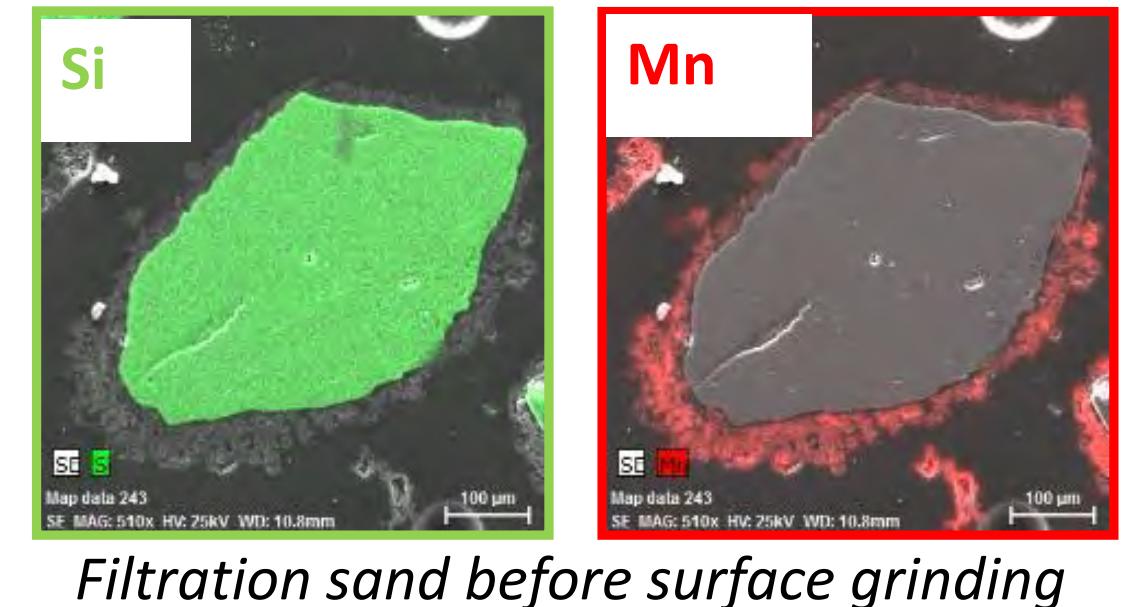


The technologies for separation and concentration of solids determine the overall process efficiency

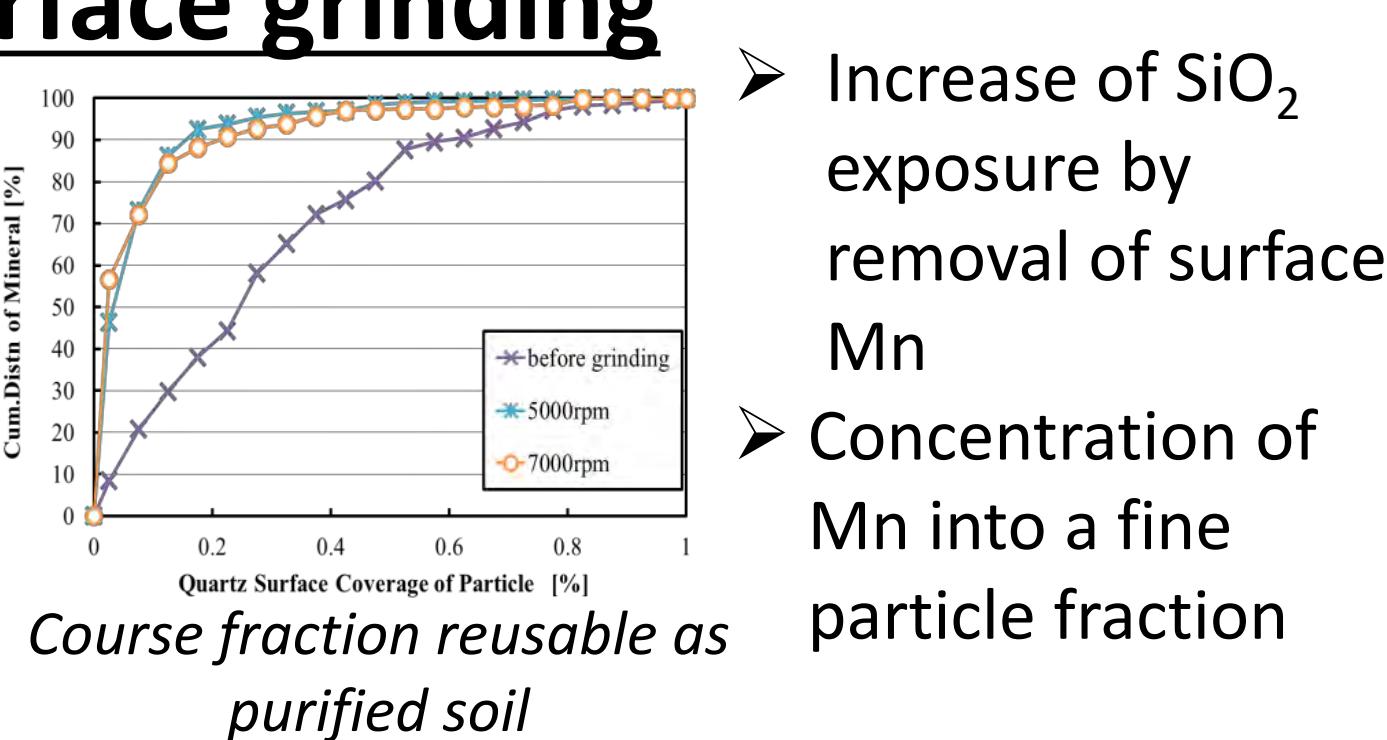


### Special grinding technologies for separation of solids

#### Soil Remediation by surface grinding

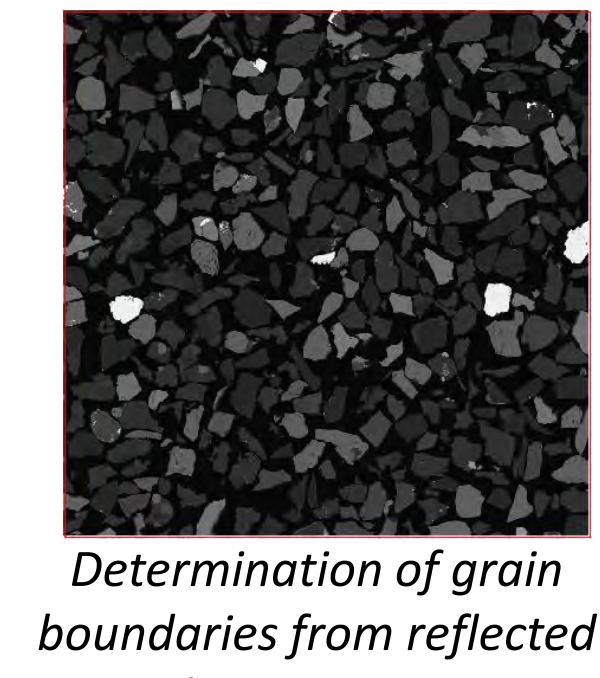


Filtration sand before surface grinding

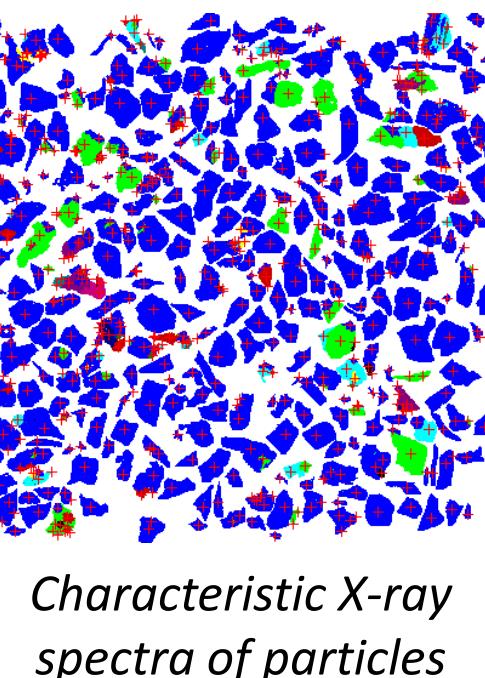


#### Solid analysis to investigate the mineral separation

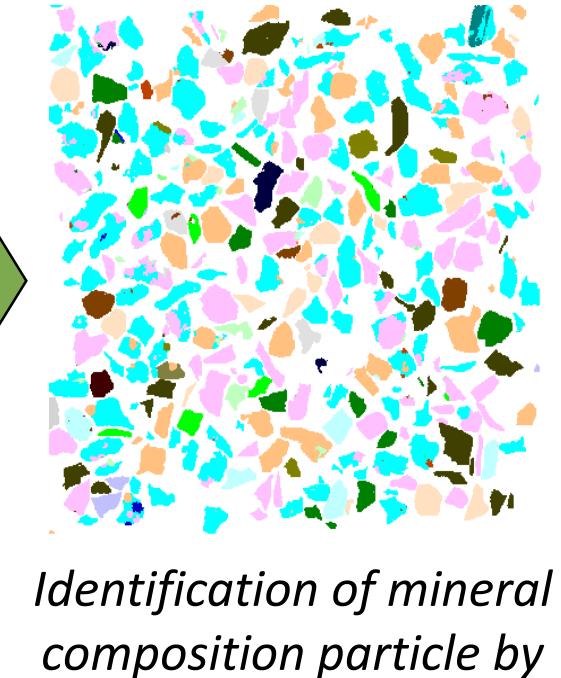
##### Mineral Liberation Analyzer (MLA)



Determination of grain boundaries from reflected electron image



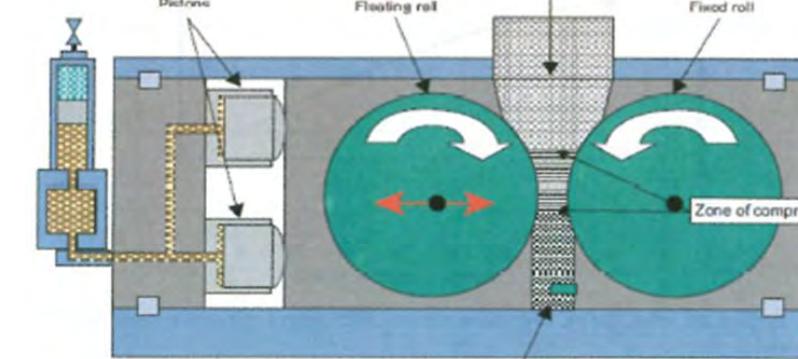
Characteristic X-ray spectra of particles



Identification of mineral composition particle by particle

- Increase of SiO<sub>2</sub> exposure by removal of surface Mn
- Concentration of Mn into a fine particle fraction

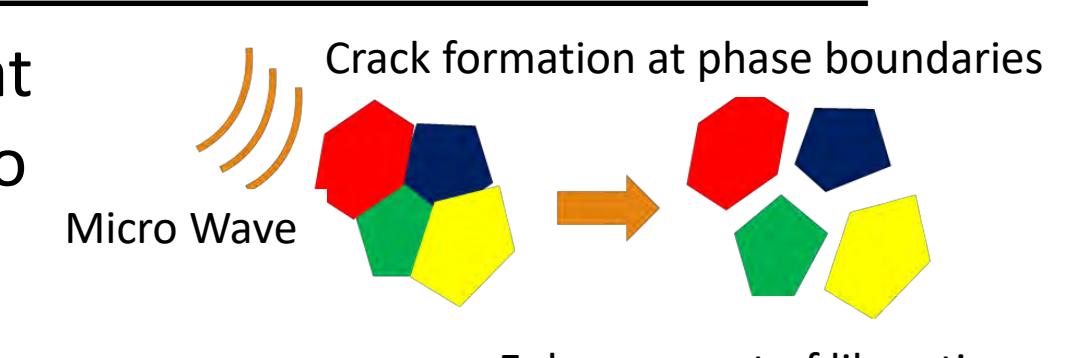
#### High Pressure Grinding Roller (HPGR) for selection of heterogenous minerals through boundary fracture



- Selective destruction at the interface of heterogeneous mineral phases by high compressive stress
- Separation and elucidation of fracture mechanism

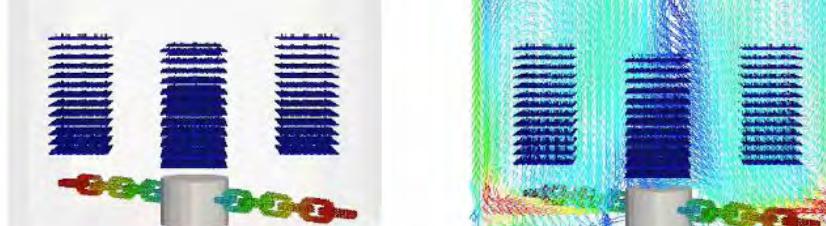
#### Control of mineral sorting by microwave irradiation

- Selective isolation of mineral phases by heat
  - a. crack formation at phase boundaries due to different thermal expansion
  - b. selective change of surface properties



#### Optimization of crushing operations by simulations

Analysis of substrate and fluid behavior in the crusher

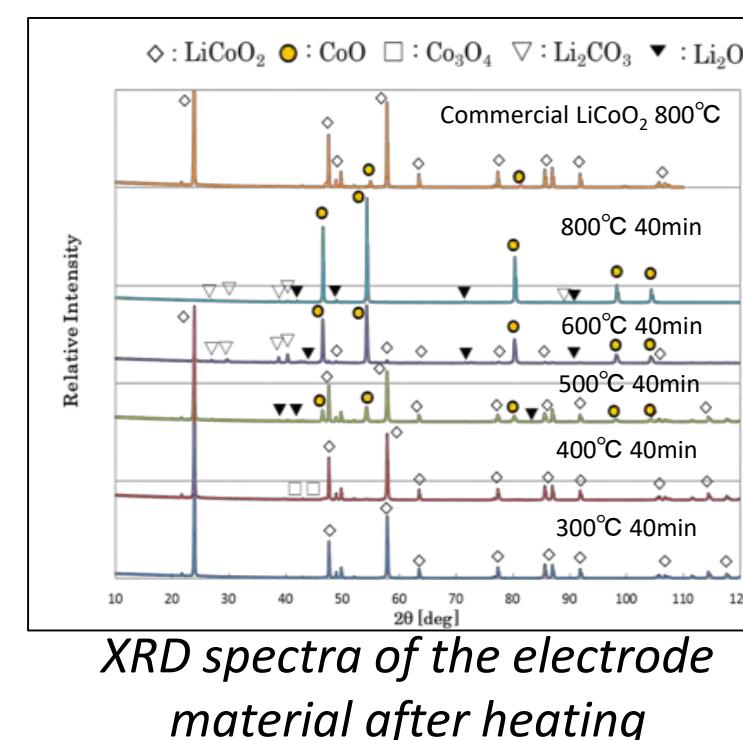
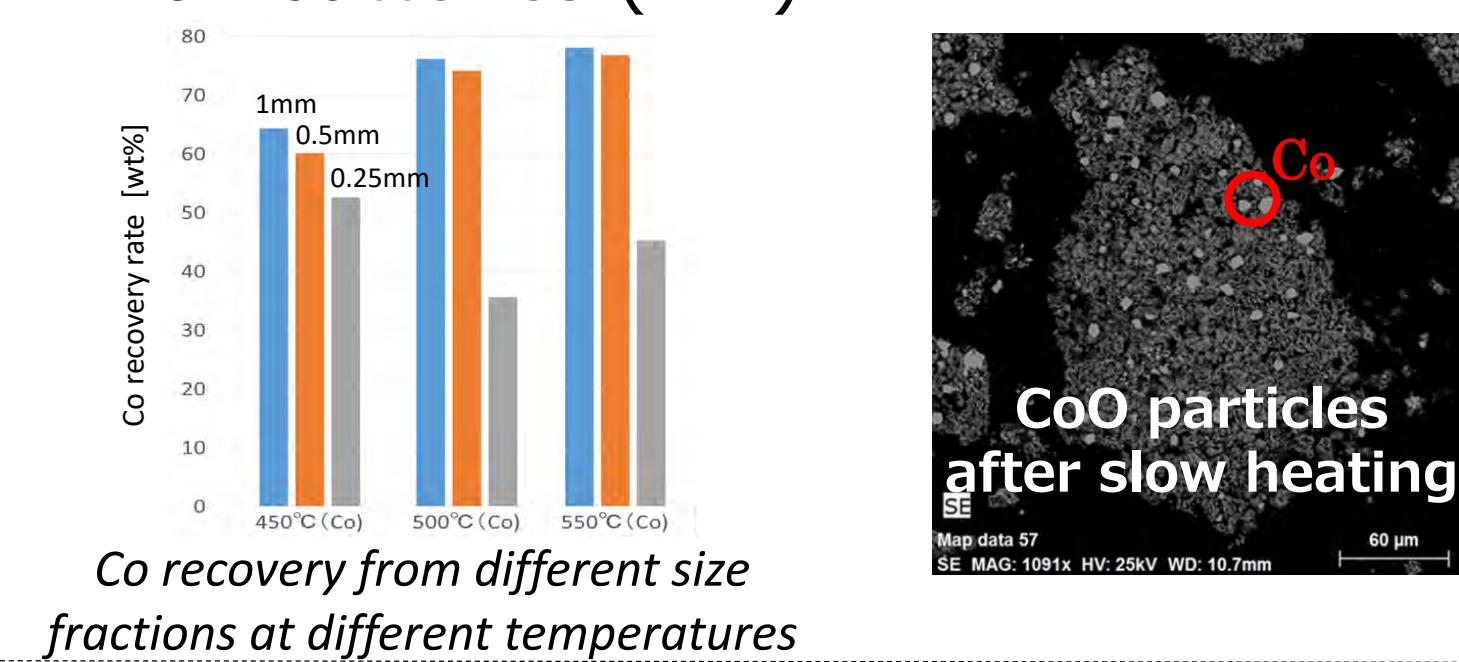


- Estimation of grinding performances by analysis of collisions between stirrer and substrate
- Possible elucidation of stirring and granulation mechanisms

### Pretreatment operations for improving the solid separation

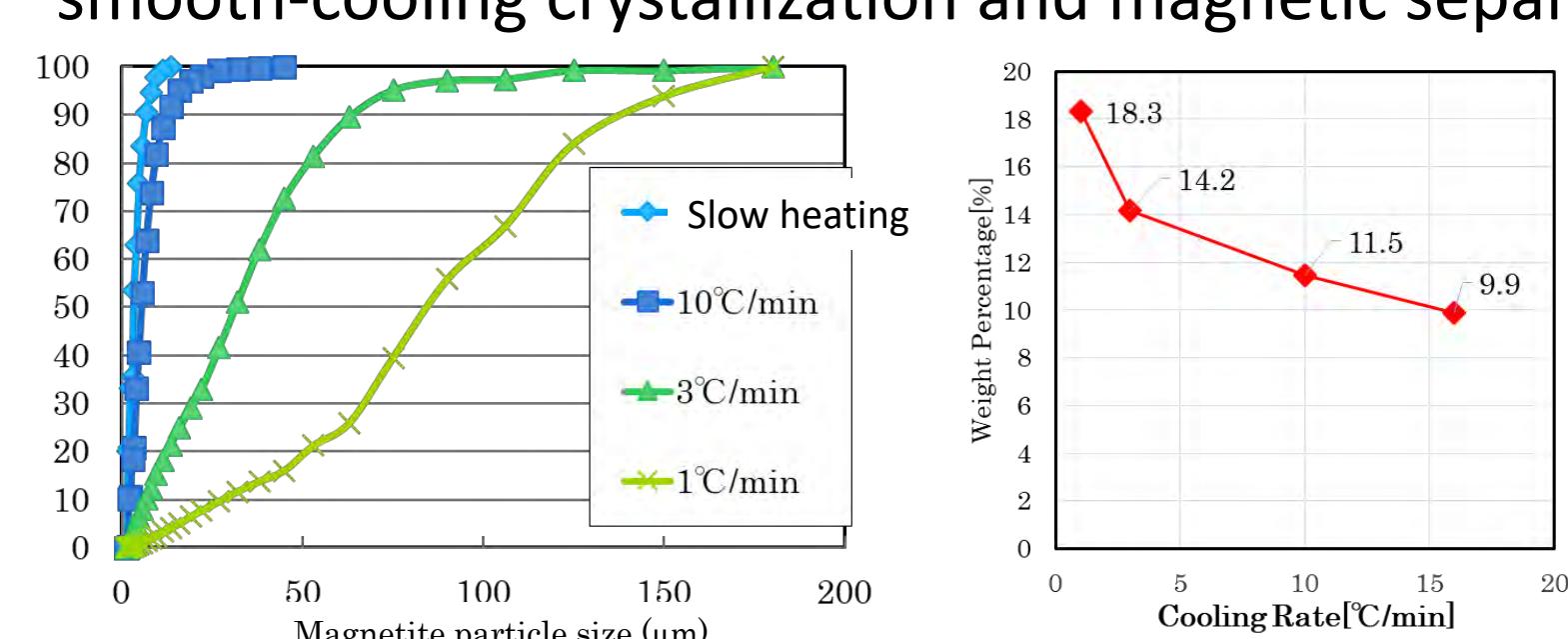
#### Recovery of Co from Li-Ion batteries by slow heating

- Process analysis to improve the recovery of valuable metals from Li-ion batteries (LIB)



#### Recovery of magnetite by slow-cooling crystallization

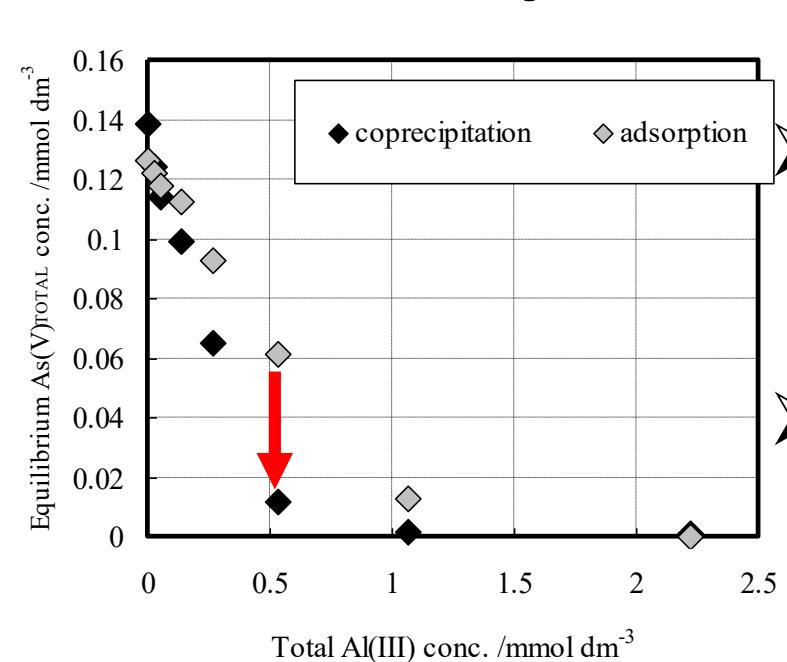
- Study of the separation of magnetite from an amorphous phase slag via smooth-cooling crystallization and magnetic separation



- magnetite particle size and precipitation rate increased by decreasing the cooling rate

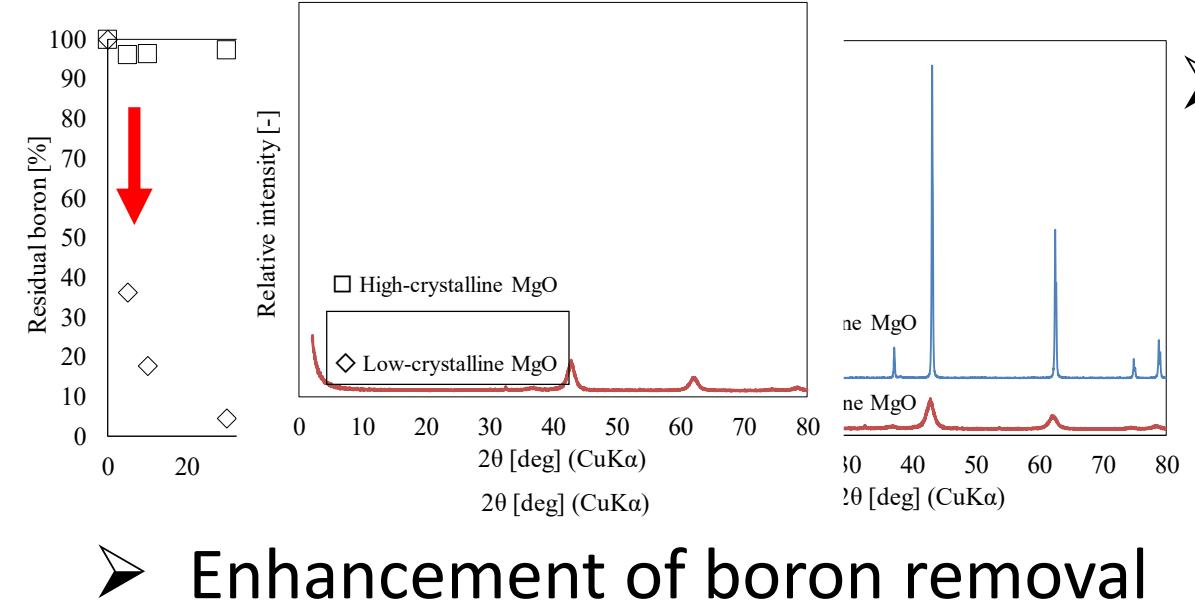
### Advanced technologies for environment remediation

#### As removal by surface precipitation



- Study and optimization of surface precipitation
- Possible recovery of inorganic elements in high efficiency

#### Removal enhancement by amorphization



- Enhancement of boron removal

- Calcination of MgCO<sub>3</sub> to MgO and quenching to suppress crystallization

#### Process optimization by combination of geochemical modeling and fluid analysis

