

SHIKAZONO LAB.

[Solid Oxide Fuel Cell (SOFC) and Next Generation Heat Engines]

Collaborative Research Center for Energy Engineering

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Thermal Energy Engineering

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Polarization Characteristics and Microstructures of SOFC Electrodes

In solid oxide fuel cell (SOFC) electrodes, three phase boundary and tortuosity of diffusion paths strongly affect the polarization characteristics. Three dimensional electrode microstructure is quantified by FIB-SEM, and simulated by lattice Boltzmann and level set methods.

- ◆ **Dual Beam FIB-SEM** : Reconstruction of microstructures with resolution up to 10 nm.
- ◆ **Lattice Boltzmann method** : Coupled simulation of diffusion and electrochemical reaction.
- ◆ **Level set simulation** : Quantification of curvatures, contact angles and surface tensions.

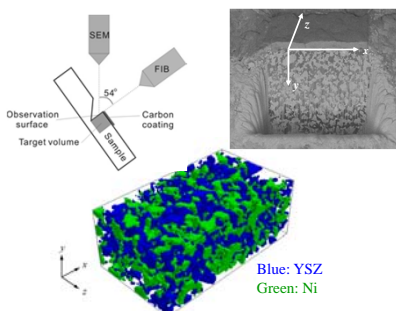


Fig. 1 Dual Beam Focused Ion Beam-Scanning Electron Microscope

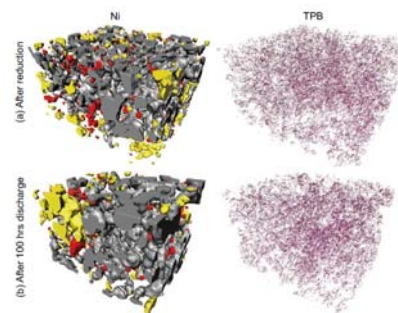


Fig. 2 Temporal change of Ni and three phase boundary of Ni-YSZ anode

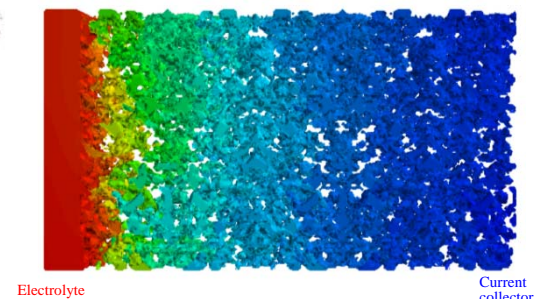


Fig. 3 Oxide ion electrochemical potential distribution inside polarized anode

R & D of Next Generation Heat Engines

Novel component technologies such as finless heat exchanger, gas-liquid separator and oblique wavy surface heat exchanger are proposed and developed. They are designed and fabricated under collaboration with industry partners.

- ◆ **Single tube oscillating steam cycle**
- ◆ **Development of novel heat transfer enhancement technique with oblique wavy surface**
- ◆ **Development of compact gas-liquid separator using surface tension**
- ◆ **Development of compact finless heat exchanger made of stainless steel**

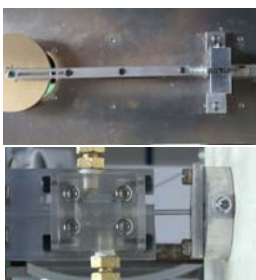


Fig. 4 Demonstration of single tube oscillating steam cycle

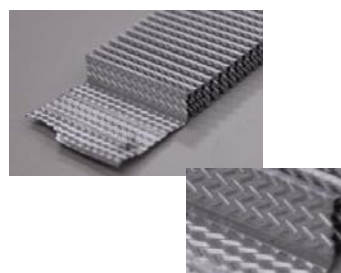


Fig. 5 Novel heat transfer enhancement technique with oblique wavy surface



Fig. 6 Compact gas-liquid separator using surface tension

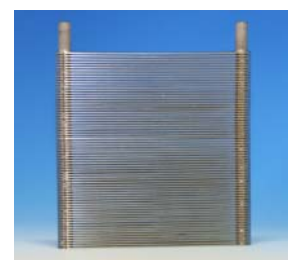


Fig. 7 SUS compact finless heat exchanger