

# SHIKAZONO LAB.

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

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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 phase field methods.

**Dual Beam FIB-SEM** : Reconstruction of microstructures with resolution up to several nm.

**Lattice Boltzmann method** : Coupled simulation of diffusion and electrochemical reaction.

**Phase field simulation** : Quantification of curvatures, contact angles and surface tensions.

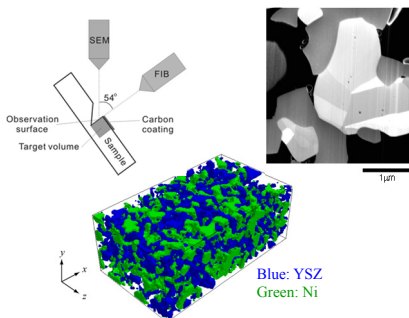


Fig. 1 Dual Beam Focused Ion Beam-Scanning Electron Microscope

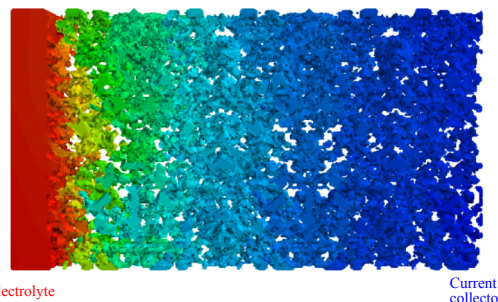


Fig. 2 Oxide ion electrochemical potential distribution inside polarized anode

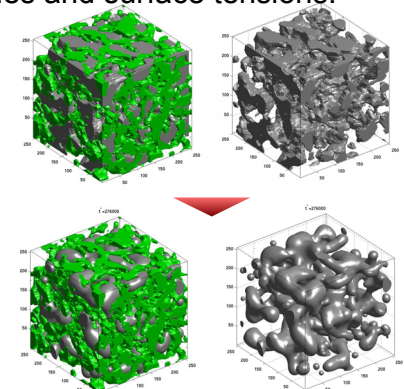


Fig. 3 Phase field simulation of Ni (gray) sintering in Ni-YSZ anode

### R & D of Next Generation Heat Engines

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

**Trilateral and oscillating steam cycles**

**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**

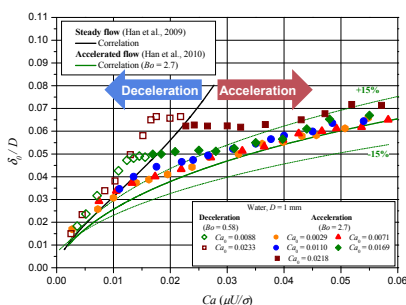


Fig. 4 Liquid film thickness in accelerated and decelerated slug flow

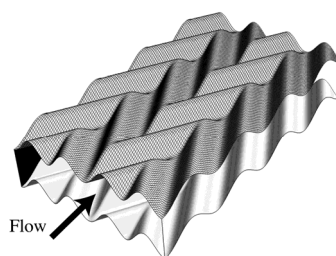


Fig. 5 Novel heat transfer enhancement technique with oblique wavy surface



Fig. 6 Compact gas-liquid separator using surface tension

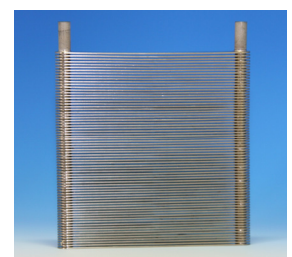


Fig. 7 SUS compact finless heat exchanger