

SHIKAZONO LAB.

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

Collaborative Research Center for Energy Engineering

<http://www.feslab.iis.u-tokyo.ac.jp/>

Thermal Energy Engineering

Department of Mechanical Engineering

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.

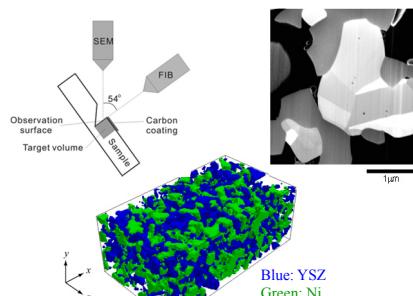


Fig. 1 Dual Beam Focused Ion Beam-Scanning Electron Microscope

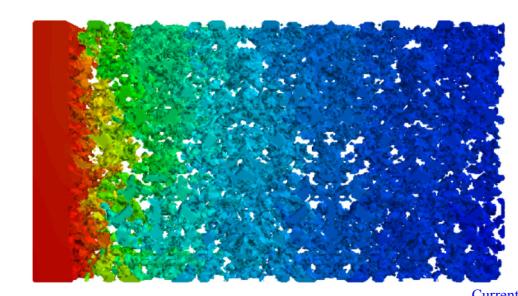


Fig. 2 Oxide ion electrochemical potential distribution inside polarized anode

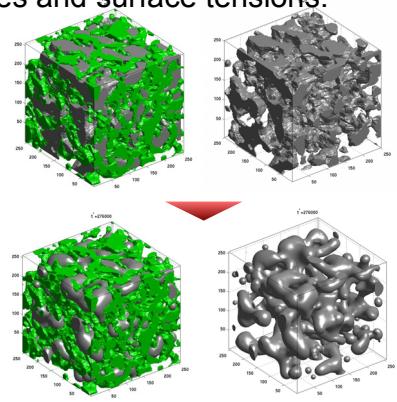


Fig. 3 Phase field simulation of Ni (gray) sintering in Ni-YSZ anode

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

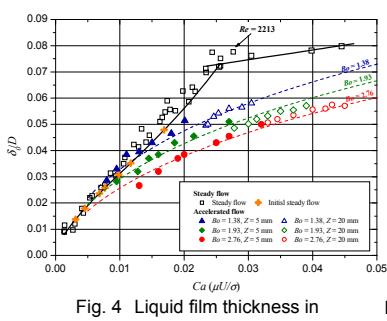


Fig. 4 Liquid film thickness in accelerated slug flow

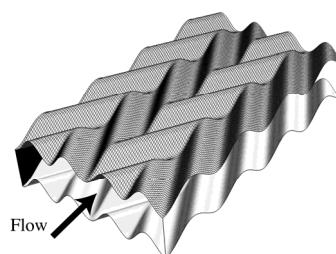


Fig. 5 Novel heat transfer enhancement technique with oblique wavy surface



Fig. 6 Compact gas-liquid separator using surface tension



Fig. 7 SUS compact finless heat exchanger