

# SHIKAZONO LAB.

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

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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.

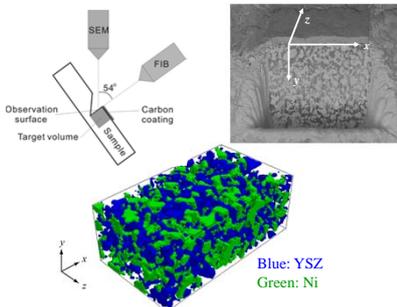


Fig. 1 Dual Beam Focused Ion Beam-Scanning Electron Microscope

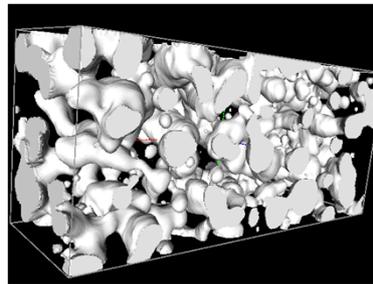


Fig. 2 Nickel surface quantified by level set method

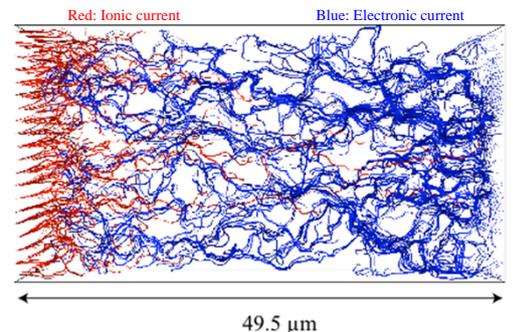


Fig. 3 Ionic and electronic current stream lines in Ni-YSZ anode

### Development of Technologies for 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.

- ◆ **Measurement and modeling of micro-scale two phase flows**
- ◆ **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**

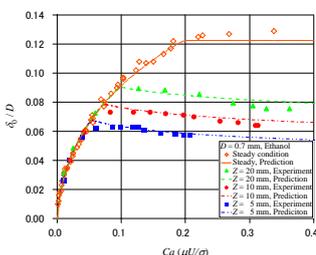


Fig. 4 Liquid film thickness in accelerated micro tube

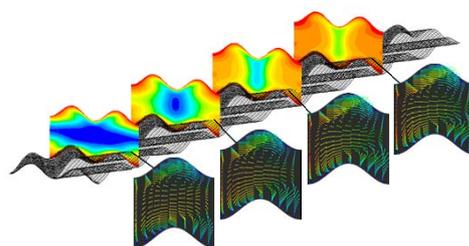


Fig. 5 New heat transfer enhancement technique with oblique wavy surface



Fig. 6 Compact gas-liquid separator using surface tension



Fig. 7 SUS compact finless heat exchanger