

# SHIKAZONO LAB.

## Low Exergy Loss Energy Conversion



Department of Mechanical and Biofunctional Systems  
 Research Center for Sustainable Material Energy Integration, Energy System Integration Social Cooperation Program

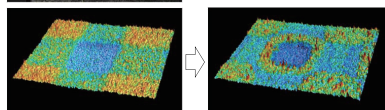
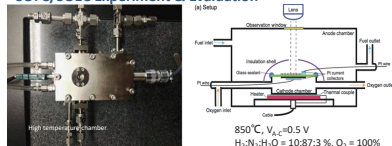
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<http://www.feslab.iis.u-tokyo.ac.jp/index-e.html>

## Electrode Microstructures of Solid Oxide Fuel Cell (SOFC) & Electrolysis Cell (SOEC)

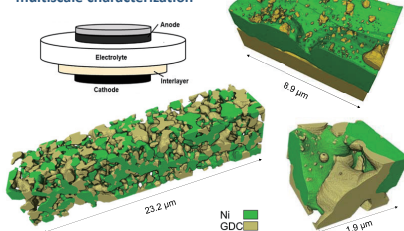
Electrode microstructures strongly affects the performance and reliability of solid oxide fuel cells (SOFCs) and electrolysis cells (SOECs). Numerical simulation tools such as lattice Boltzmann, phase field, kinetic Monte Carlo and discrete element methods as well as machine learning tools, e.g. CNN, CGAN, UNIT, LSTM, PINN, etc. are developed to investigate the electrode characteristics from initial powder to long time operation. Three dimensional microstructures reconstruction by FIB-SEM and operando observations play inevitable role for understanding the phenomena and model validation.

### SOFC/SOEC Experiment & Evaluation



Operando observations of patterned Ni-GDC electrodes under real operation.

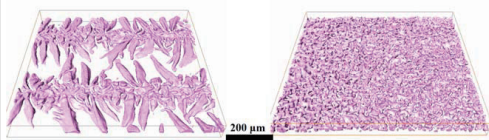
### Electrode microstructure multiscale characterization



## Next Generation Heat Pumps & Heat Engines

Efficient utilization of thermal energy is becoming even more important to reduce final energy consumption. In order to reduce exergy loss, heat cycles which operate at small temperature difference, and component technologies such as efficient heat exchangers and gas-liquid separators are developed under collaboration with industry partners.

- Novel steam/refrigerant cycles (2 phase expansion/compression, Lorenz cycle)
- 3D measurement of frost microstructure
- Heat exchangers and gas-liquid separators, etc.



Reconstruction of frost 3D microstructures

