

Research topics for graduate students for 2023

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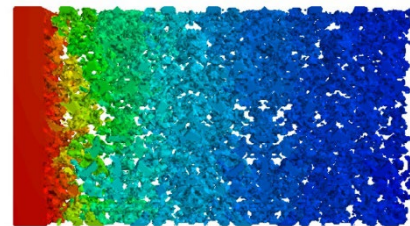
Acceptable course(s)

- Master's Degree
- Doctoral Degree



Research Topics

The major areas of research are the characterization and simulation of solid oxide fuel cell (SOFC) and solid oxide electrolysis cell (SOEC) electrodes [1], component technologies such as efficient heat exchangers and gas-liquid separators for next generation heat engines [2].

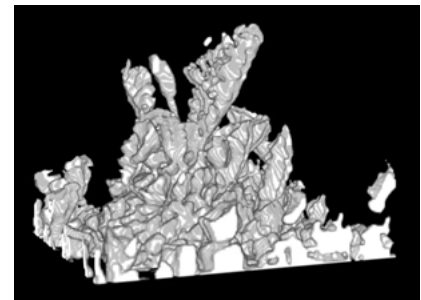


1. Polarization Characteristics and Microstructures of Solid Oxide Cell Electrodes

Electrode microstructures strongly affect the polarization characteristics of solid oxide fuel cells (SOFCs). Machine learning, e.g. convolutional neural network and conditional generative adversarial network as well as large-scale numerical simulations such as lattice Boltzmann, phase field, kinetic Monte Carlo and discrete element methods are developed to optimize the whole lifetime characteristics of the electrodes from initial powder to long time operation. Three dimensional microstructures reconstruction by focused ion beam scanning electron microscopy and in operando observations play inevitable role to understand the phenomena and to validate the developed models.

2. Heat and Mass Transfer in Next Generation Heat Engines

Efficient utilization of thermal energy will become even more important in the future energy systems. 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. Figure on the right shows the three dimensional structure of frost reconstructed by replica method [2].



Articles Related to Research Topics

- [1] Ouyang, Z., Komatsu, Y., Sciazko, A., Onishi, J., Nishimura, K. and Shikazono, N., Operando observations of active three phase boundary of patterned nickel - yttria stabilized zirconia electrode in solid oxide cell, *J. Power Sources*, 529, 231228 (2022). [DOI: 10.1016/j.jpowsour.2022.231228]
- [2] Takayashiki, M., Nishimura, K., Sciazko, A., Okabe, T., Taniguchi, J. and Shikazono, N., Three Dimensional Reconstruction of Frost Structure by Replica Method, *Int. J. Heat Mass Transf.*, 196, 123280 (2022). [DOI: 10.1016/j.ijheatmasstransfer.2022.123280]

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