

Research topics for graduate students for 2025

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Acceptable course(s)

- Master's Degree
- Doctoral Degree

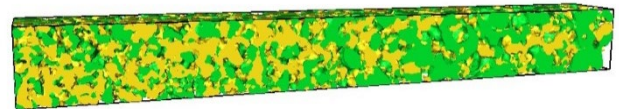


Research Topics

The main research topic is development of energy technologies such as solid oxide fuel cells (SOFCs) and solid oxide electrolysis cells (SOECs), which are electrochemical devices that can operate at temperatures as high as 600-1000°C, and steam engines and heat pumps that operate at temperatures of several hundred degrees or lower.

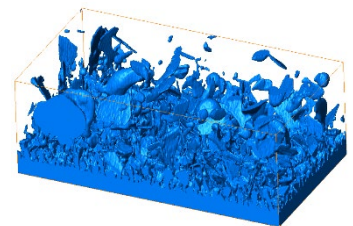
1. Electrode Microstructures of Solid Oxide Fuel Cell (SOFC) & Electrolysis Cell (SOEC)

Electrode microstructures strongly affects the performance and reliability of solid oxide fuel cells (SOFCs) and electrolysis cells (SOECs). Machine learning, e.g. CNN, CGAN, UNIT, LSTM, PINN etc., as well as numerical simulations such as lattice Boltzmann, phase field, kinetic Monte Carlo and discrete element methods are developed to optimize the characteristics of the electrodes 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.



2. Research and Development on Heat Pumps & Heat Engines

Efficient utilization of thermal energy is becoming even more important to reach carbon neutrality. 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.



Articles Related to Research Topics

- [1] Han, Y. and Shikazono, N., Measurement of the liquid film thickness in micro tube slug flow, *Int. J. Heat and Fluid Flow*, Vol. 30, pp. 842-853 (2009).
- [2] Iwai, H., Shikazono, N., Matsui, T., Teshima H., Kishimoto M., Kishida R., Hayashi D., Matsuzaki K., Kanno D., Saito M., Muroyama H., Eguchi K., Kasagi N. and Yoshida H., Quantification of Ni-YSZ Anode Microstructure Based on Dual Beam FIB-SEM Technique, *J. Power Sources*, 195 (4), pp. 955-961 (2010).
- [3] Shikazono, N., Kanno, D., Matsuzaki, K., Teshima, H., Sumino, S. and Kasagi, N., Numerical Assessment of SOFC Anode Polarization Based on Three-Dimensional Model Microstructure Reconstructed from FIB-SEM Images, *J. Electrochem. Soc.*, 157 (5), pp. B665-B672 (2010).

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