

## Research topics for graduate students for 2024

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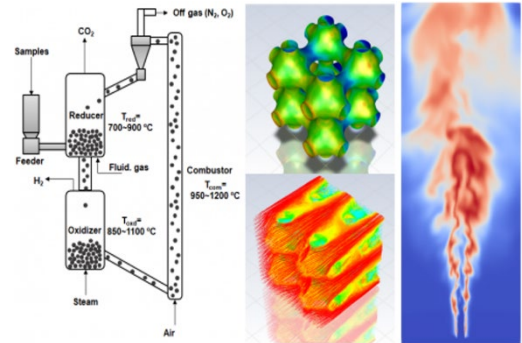
Acceptable course(s)

- Master's Degree
- Doctoral Degree



#### Research Topics

A highly efficient and clean energy system is developed toward the realization of a sustainable society. Analysis and modeling of micro to macro-scale for each individual energy conversion process and elemental technology are performed, together with the efforts to integrate them efficiently. In addition, a mutual correlation (conversion and utilization) among non-carbon based secondary energy sources is also studied.



#### 1. Integrated energy conversion and multi generation system

An integrated multi generation system, including electricity, chemical fuels, and heat, is proposed and analyzed under both steady and dynamic conditions. The optimization of massive adoption of renewable energy is conducted, and their optimal conversion to non-carbon-based secondary energy resources is proposed [1].

#### 2. Advanced hydrogen production, storage/transportation, and utilization

The hydrogen production employs chemical looping which is able to separate CO<sub>2</sub> and produce highly pure hydrogen [2], while its storage is focused on ammonia, liquid hydrogen, and metal hydride. For the utilization, advanced hydrogen combustion is simulated, and the accumulated data are trained using physics informed neural network for accurate prediction and realization of digital twin technology.

#### 3. Energy conversion of low-rank fuels and novel energy storage

The conversion of low-rank fuels, such as waste and biomass, is studied to optimize their utilization, as well as solve the environmental problems. In addition, new ideas on advancements of energy storage including non-vanadium redox flow battery and crack analysis in solid-state battery (following the charging and discharging cycles).

#### Articles Related to Research Topics

- [1] D Wen, M Aziz. Flexible operation strategy of an integrated renewable multi-generation system for electricity, hydrogen, ammonia, and heating. *Energy Conversion and Management*, 253, 115166, 2022
- [2] Z Sun, et al. Highly integrated system for ammonia and electricity production from biomass employing direct chemical looping: Exergy and exergoeconomic analyses. *Energy Conversion and Management*, 251, 115013, 2022
- [3] LA Lesmana, M Aziz. Adoption of triply periodic minimal surface structure for effective metal hydride-based hydrogen storage. *Energy* 262 (2022) 125399

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