Research topics for graduate students for 2024

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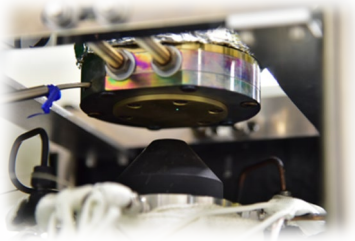
Acceptable course(s)

- Master's Degree
- Doctoral Degree

Research Topics

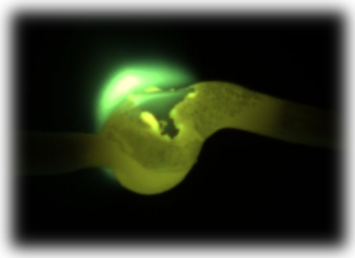
With a particular emphasis on improving efficiency and minimizing the environmental impact of energy conversion processes, we clarify the complex thermo-fluid phenomena involving chemical reactions across diverse applications.

1. Cool flames for advanced combustion control



Cool flames play a pivotal role in autoignition, knocking, and multi-ignition phenomena in IC engines. Consequently, comprehending their combustion behavior and accurately modeling the low-temperature chemistry are essential for achieving high thermal efficiency alongside reduced pollutant emissions. Our research primarily focuses on elucidating the cool flame characteristics and investigating the wall chemical effects on cool flames, utilizing advanced laser diagnostics and numerical simulations.

2. Clean energy conversion based on metal oxidation/reduction



Specific metals are garnering interest as a promising carbon-free energy source, thanks to their high volumetric energy density and recyclability. Our research centers on exploring their potential not only as an efficient energy carrier in the energy conversion process but also as a medium for reducing CO_2 and H_2O to synthesize clean hydrocarbon fuels.

3. Fuel ammonia for hydrogen society

Ammonia is anticipated to serve as a hydrogen carrier; however, its combustibility also enables its direct use as a carbon-free fuel. Our research is devoted not only to understanding the fundamental mechanisms of ammonia combustion and cracking (reforming) but also to addressing the practical challenges encountered when implementing ammonia in industrial applications, such as gas turbines and furnaces.

Articles Related to Research Topics

[1] P. Feng et al., *Int. J. Hydrog. Energy*, **48**, 29209 (2023). [DOI: 10.1016/j.ijhydene.2023.04.106]

[2] T. Mizuno et al., *Fuel*, **348**, 128587 (2023). [DOI: 10.1016/j.fuel.2023.128587]

[3] M. Lee et al., *Combust. Flame*, **231**, 111476 (2021). [DOI: 10.1016/j.combustflame.2021.111476]

Lab. Web page: http://www.mesl.t.u-tokyo.ac.jp