Research topics for graduate students for 2023

Professor Yuji Suzuki

Department of Mechanical Engineering

Acceptable course(s)

- Master's Degree
- Doctoral Degree

Research Topics

In my group, we carry out various researches related to energy problems from flame to wall interaction, which is important in macroscale combustion systems, to mobile/wearable power source using thermoelectric generation/energy harvesting. Independent self-motivated international students are always welcome to our group!

1. Elucidation of flame to wall interaction of hydrocarbon/ammonia fuels using LIF/TALIF

We have recently found that, when flame is located near the wall, there are significant chemical interactions between the flame and the wall. Through high-spatial-resolution laser induced fluorescence (LIF) or two photon absorption LIF (TALIF), detailed mechanisms are investigated both for normal flame [1] and cool flame. We also focus on two-way interactions between ammonia flames and metal wall surfaces through nitriding.

2. Development of fuel-based mobile power source using high temperature thermoelectric module

For social implementation of autonomous robots, fuel-based mobile power sources that can substitute conventional lithium-ion batteries is required. A monolithic SiGe thermoelectric module directly-heated by catalytic combustion is developed in order to overcome limitations of previously-proposed combustion-based Bi-Te systems [2].

3. Development of high-performance polymer electret and its application to vibration energy harvesting

Quantum chemical analysis and machine learning are employed to enhance the charging performance of amorphous fluorinated polymer electret [3]. Record-high surface charge density of 4 mC/m^2 has been obtained. With the electret material developed, a wrist-worn rotational electret energy harvester for powering low-power electronics from human arm swing is also prototyped, which can generate extremely-high output power of 1.3 mW at 1 rps.

Articles Related to Research Topics

[1] Fan, Y., et al., "Evaluation of Wall Chemical Effect in Hydrogen Flame," Proc. Combust. Inst., Vol. 38, pp. 2361-2370, (2021). [doi:10.1016/j.proci.2020.06.021]

[2] Uchida, S., et al., "High-temperature Monolithic SiGe Thermoelectric Device Directly-Heated by Catalytic Combustion," Appl. Phys. Lett., Vol. 120, Issue 5, 053901 (2022). [doi:10.1063/5.0077157]

[3] Zhang, Y., et al., "Discovery of Polymer Electret Material via de Novo Molecule Generation and Functional Group Enrichment Analysis," Appl. Phys. Lett., Vol. 118, Issue 22, 223904 (2021). [doi:10.1063/5.0051902)]

Lab. Web page: http://www.mesl.t.u-tokyo.ac.jp/index.html (Sorry, "Research Topic" in English page is too old).