

## Research topics for graduate students for 2024

### Associate Professor Keisuke Nagato

Department of Mechanical Engineering

Acceptable course(s)

- Master's Degree
- Doctoral Degree



#### Research Topics

The research field is production science. In particular, we focus on micro-/nanoscale microstructure surface synthesis method such as powder processes and laser manufacturing. The applications using these processes are researched such as fuel cells, functional surfaces. Not only development of process but also state-of-the-art parameter exploration system using autonomous system, i.e., combination of automatic robotic system and machine learning.



#### 1. Autonomous system for process parameter exploration

We have been developing the autonomous system for process parameter exploration [1]. Fuel cells, that are essential to realize carbon neutral society, are manufactured by complex powder process. The high-speed exploration method of the optimal process parameter in a huge parameter space.

#### 2. Impedance modeling of fuel cell

In fuel cells, as specie transfer and chemical reaction occurs complicatedly, a non-destructive method to measure microstructure properties during operation. One of the solutions is impedance modeling [2], differentiating microstructure properties in real time.

#### 3. Powder bed fusion by laser beam

Powder bed fusion with laser-beam (PBF-LB) is the highest-accuracy in metallic additive manufacturing. To clarify the mechanism at laser-spot, we are observing the meltpool, keyhole and flying particles using a high-speed observation. Also, we construct autonomous systems to discover optimal process parameters with high throughput[3].

#### Articles Related to Research Topics

[1] K. Nagai *et al.*, *Scientific Reports* **12**, 1615 (2022). [DOI: 10.1038/s41598-022-05784-w] c.f. [https://youtu.be/\\_JM4BZHsSKQ](https://youtu.be/_JM4BZHsSKQ)

[2] A. Tanaka *et al.*, *J. Power Sources* **545**, 231937 (2022). [DOI: 10.1016/j.jpowsour.2022.231937]

[3] K. Nagato *et al.*, *Mater. & Des.* **227**, 111696 (2023) [DOI: 10.1016/j.matdes.2023.111696] c.f. <https://youtu.be/e6DkPa10jv4>

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