

# Bachelor/Master-Thesis

## Understanding the Nanoparticle Cloud Formation During High-Temperature Oxidation of Micrometer-sized Metal Particles

### Motivation & Background

Reactive metals such as iron (Fe), aluminium (Al), and silicon (Si) have emerged as promising carbon-free energy carriers for industrial heat and power generation. However, their practical utilization strongly depends on the efficient **recyclability** of these materials. In cyclic oxidation–reduction processes, metal microparticles are first combusted in an oxidizing atmosphere, producing metal oxide particles, which are subsequently reduced back to their metallic state using hydrogen. A **major challenge** in this cycle arises during the oxidation stage, where high surface temperatures can induce evaporation and subsequent formation of nanoparticles in the gas phase. These nanoparticles are difficult to capture, leading to unavoidable material losses. This loss directly undermines the circularity and sustainability of recyclable metal fuel systems and represents one of the key challenges in metal combustion technologies.

Our previous studies have identified several strategies to mitigate nanoparticle formation. Building on these findings, this thesis aims to further investigate the underlying mechanisms by **combining optical in-situ diagnostics and numerical simulations**. The project is embedded in a collaborative research framework involving both national and international partners. Successful outcomes may also provide opportunities to present results at workshops and conferences.

### Tasks

- Review the literature, especially single particle combustion, including experiments and simulations
- Extend existing simulation approaches to underpin potential chemical pathways
- Extend optical diagnostics to single particle experiments to measure nanoparticles
- Analyze data and results
- Intermediate and final presentations, write final theses

*Note: The specific methods and objectives will be explained in detail during the initial meeting. Feel free to get in touch via email for further information.*

### Focus areas

Experiment	● ● ●
Construction	○ ○ ○
Modeling	● ○ ○
Data analysis	● ● ○

### Date

01.03.2026

### Start from

Flexible, get in touch!

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