Microfluidics for nuclear fusion



DARMSTADT

Microfluidics

TECHNISCHE

UNIVERSITÄT

Experiments for a sustainable future (Theses)

In light of the ongoing climate and energy crisis, sustainable power generation is urgently needed. Inertial confinement fusion (ICF) is a promising alternative that uses lasers to ignite small, fuel-filled targets, triggering a fusion reaction. This all-weather technology produces no long-lived radioactive waste and poses fewer safety risks than nuclear fission. In 2022, ICF demonstrated its first net energy gain. However, there is still a long way to go before it can be commercialized.

Currently, diamond targets are used that are time- and cost- intensive while having a high rejection rate and a limited batch size. In contrast, microfluidic chips hold great promise for producing economical fusion targets. Together with the startup Focused Energy, we research on making microfluidically produced targets competitive and ensure they meet required standards.

Currently, there are these topics available:

- **Droplet Drama:** Impact of buoyancy in double emulsion droplets for dielectrophoretic centering (*Bachelor/Master*)
- Flowing disaster: Impact of flow on dielectrophoretic centered double emulsion droplets (*Master*)
- Like in Space(rs): Spacers to reduce gravity effects in double emulsion droplets (*Bachelor*)

What we offer you:

- Hands-on experiences with state-ofthe-art equipment
- Learn evaluation techniques, including image processing in Python
- Individualized guidance
- Research field: micro fluidics, electrostatics
- Working with a dynamic startup team

Feel free to write me a mail: bauer@nmf.tudarmstadt.de

I am looking forward to hearing from you!!



Cone Metal cone to protect the foil and guide the ion beam to the center of the target

> Ion foil Gold foil target for short-pulse lasers creating

DT ice Layer supplying high-density fuel after compression

ion beam to ignite

compressed fuel

DT gas Low density fuel

Plastic ablation layer providing rocket-like compression of the fuel when irradiated by long-pulse laser beams **Coating** Thin metal layer to seal

Shell

and protect the shell Foam

structure providing support for DT ice layer

FOCUSED