Friedrich-Alexander-Universität
Faculty of Engineering

LSTM Erlangen

Master Thesis

Two-Phase Cooling of Power Electronics

Background:

Power electronics plays a key role in the energy transition by enabling the efficient use of renewable energy sources. It is crucial for converting, controlling, and distributing electrical energy in applications such as photovoltaic systems, wind power plants, and battery storage systems. Modern power electronics improve the integration of volatile energy sources into the power grid by adjusting frequencies, regulating voltages, and minimizing losses.

To increase the dematerialization and recyclability of converters, the size of the components must be reduced. At the same time, their performance needs to be enhanced, leading to a significantly higher heat flux density. Since conventional air cooling reaches its limits under these conditions, a two-phase cooling system will be employed to cool the electronic components directly. In this process, heat is removed from the heat sources through evaporation and condensation of a coolant.

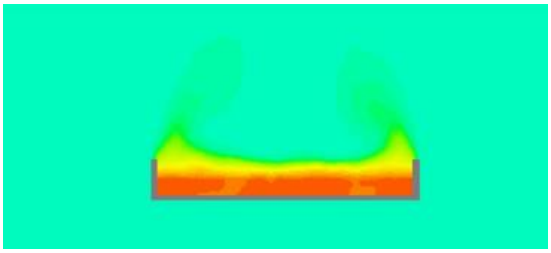

***Figure 1**: Humidity distribution in Star-CCM+ (Source: https://d-nb.info/1216822085/34)*

Tasks:

- Conduct a literature review on existing two-phase cooling systems in power electronics
- Set up a three-dimensional flow simulation of the vapor chamber in Simcenter Star-CCM+
- Perform a parametric study with different coolants and heat source values
- Evaluate the simulation results

Requirements:

- Basic knowledge of fluid mechanics and thermodynamics is required (ideally having completed NMTFD1 & NMTFD2)
- Previous experience with CFD (preferably Star-CCM+) is helpful
- Independent and structured work is required
- Motivation to solve complex fluid mechanical problems is essential

Starting date: Immediately, flexible

Advisor: Tobias Grauvogl, M. Sc.
Tel.: +49 9131 85-28291
tobias.grauvogl@fau.de