Summer trainee project 2026, Department of Applied Physics

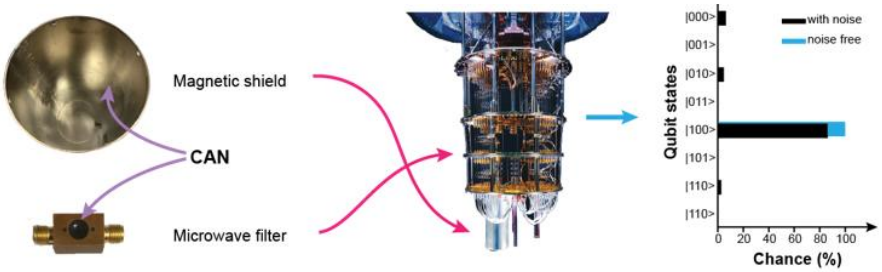
Cryogenic Absorption Nanocomposites for High Fidelity and Energy Efficient QPU

Summary:

This is a project of experimental material chemistry, which was built up on the previous findings in MXene based nanocomposites materials for EMI applications. The project can be suitable for a bachelor's thesis, a special assignment, or a master's thesis, and its difficulty can be adjusted to your level. The project will be carried out and supervised in the Multifunctional Nanocomposites group led by Dr. Zhongpeng Lyu (zhongpeng.lyu@aalto.fi), and it will be co-supervised by Prof. Olli Ikkala (olli.ikkala@aalto.fi). In the project, you will also work closely with Quantum Computing and Devices (QCD) group led by Prof. Mikko Möttönen.

Background:

Quantum computing holds immense potential to revolutionize fields such as materials discovery, energy optimization, climate modeling, and artificial intelligence, paving the way for sustainable technological advancements. However, a critical challenge hindering the scalability and performance of quantum computers is electromagnetic (EM) noise, which disrupts qubit coherence and compromises computational accuracy. Existing solutions primarily focus on blocking or reflecting noisy photons rather than efficiently absorbing them. More efficient solutions are prevented by the lack of high-absorption, non-magnetic materials that are specifically tailored for cryogenic quantum environments. Such materials are essential to enhance accuracy and efficiency while reducing power consumption to unlock the full potential of quantum computing.



Tasks:

In this project, you will be working with a 2D material-based nanocomposite coating designed for broadband electromagnetic absorption across the GHz–THz range, minimizing external noise of superconducting quantum processors. Especially, you will fabricate the coating material with various compositions and apply them to the superconducting quantum computers to exam their mechanical robustness and EM absorption performance.

Prerequisite:

Inorganic chemistry, surface chemistry, basic electronics (bonus)