NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2021-2022

Transport properties of an Al/Ge/Al junction

General Scope :
The internship is motivated by our recent investigations of ultra-scaled hybrid Al/Ge devices that we achieved using bottom-up grown Germanium nanowires and a selective thermal induced Al/Ge exchange reaction. It leads to pure and remarkable atomically sharp interfaces between Al and Ge as shown on the figure1. Integrating such structures in a Josephson field-effect transistor (FET) we were able to demonstrate highly transparent interfaces and superconducting proximity effect through a pure Ge segment. These results imposed already such Al/Ge devices as promising candidates for superconducting qubits.

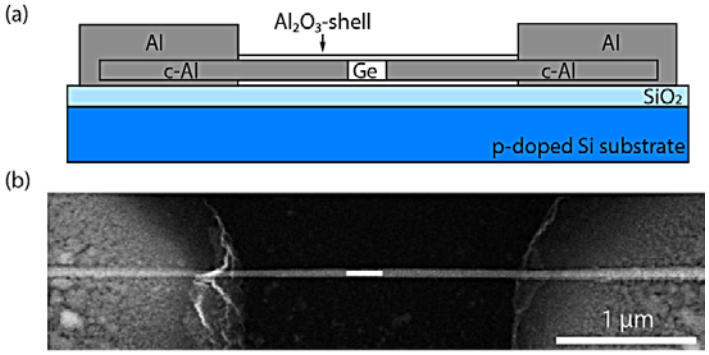

Figure 1: (a) Schematic illustration of the passivated Al-Ge-Al NW heterostructure comprising one-dimensional self-aligned Al leads contacting a Ge segment. (b) TEM image showing an Al-Ge-Al heterostructure device

Research topic and facilities available :
Our research aims at exploring superconductor/semiconductor hybrid devices based on ultra-scaled Al/Ge heterostructures and their integration in functional quantum circuits. The transport properties of such Al/Ge hybrid devices demonstrated a rich variety of promising properties ranging from a supercurrent through the junction to Coulomb diamonds related to the germanium quantum dot. We will explore these properties in a homemade He3 cryostat which allows to measure at 350 mK.

Possible collaboration and networking : The internship proposal is related to a joint proposal between the Neel institute and the Technical University of Vienna (Austria).

Possible extension as a PhD : Not funded

Required skills: Master in condensed physics

Starting date : **March or April 2022**

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More information : https://neel.cnrs.fr/equipes-poles-et-services/circuits-electroniques-quantiques-alpes-quanteca