INSTITUT NEEL Grenoble

Proposition de stage Master 2 - Année universitaire 2020-2021

Quantum transport in a superconducting/semiconducting 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 figure 1. 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.

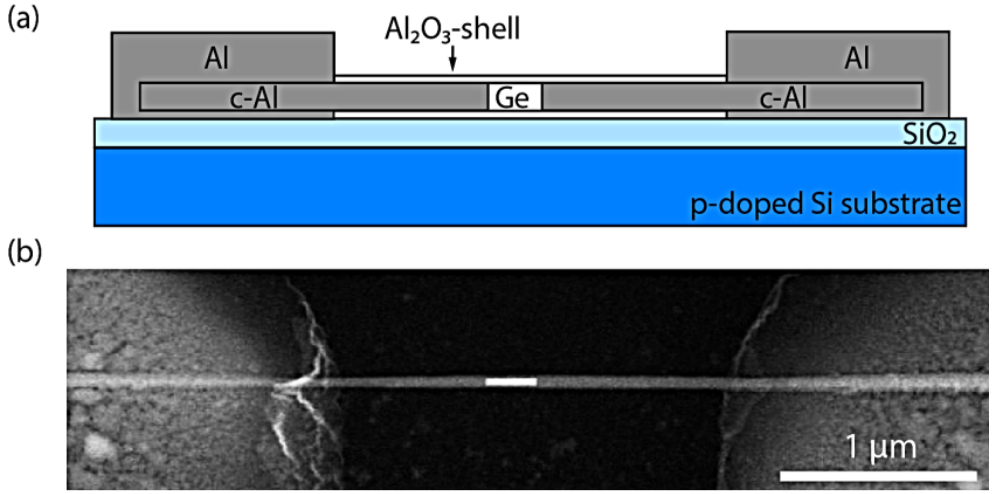

Figure 1: (a) Schematic illustration of the passivated Al-Ge-Al NW heterostructure comprising one-dimensional self-aligned Al leads contacting a Ge segment. (b) TEM image showing an Al-Ge-Al heterostructure device. The central white segment is the germanium.

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 quantum transport properties of such Al/Ge hybrid devices demonstrated a rich variety of promising properties ranging from a Coulomb diamonds related to the germanium quantum dot, a supercurrent through the junction up to superconducting qubits. We will explore some of these properties in a homemade He_3 cryostat which allows to measure down to 350 mK. The internship is aimed to be followed by a PhD.

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

Required skills: Master or Engineering degree. Skills on solid state physics or quantum transport will be appreciated. Motivation on experimental nanophysics is needed.

Starting date: March or April 2021

Contact : Naud Cécile
Institut Néel - CNRS : cecile.naud@neel.cnrs.fr
Plus d'informations sur : http://neel.cnrs.fr