NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2020-2021

Thermoelectric thin films

General Scope:

The aim of this internship is to develop and characterize Heusler Fe-V-Al thermoelectric thin films for electrical microgeneration or thermoelectric microcooler applications.

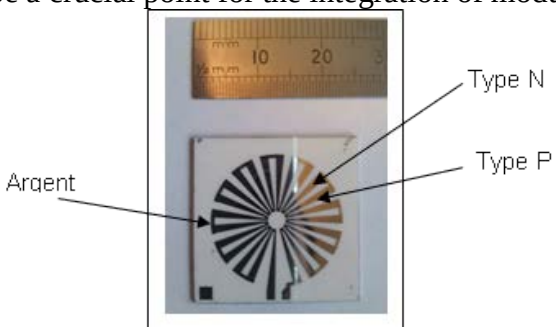
Thermoelectricity is a field that has emerged in recent years and on which many research teams around the world are working. Converting heat into electrical current has become a challenge that is currently researched by many manufacturers. In addition, technological developments are forcing products and systems to become increasingly miniaturized. As a result, the materials are subject to much higher stresses and the thermal effects generated by small systems will become critical.

Thin films seem to be of great interest to meet the specifications of some products developed by different companies. In addition, recent studies show that thin films have significantly higher thermoelectric performance (up to a factor of 3) than those obtained in solid materials.

Research topic and facilities available:

During this internship, thin films will be developed by magnetron sputtering and annealed under different conditions. Measurements of carrier concentration and mobility will be made on thin films obtained. These experiments coupled with thermoelectric properties (Seebeck effect S, electrical resistivity ρ, and thermal conductivity λ) will optimize the merit factor $ZT=S^2\sigma T/\lambda$ which is characteristic of thermoelectric efficiency. Compositions, phases in the presence and microstructures of thin films will be analyzed by X-ray diffraction, SEM-FEG and EDX. Doping effects on thermoelectric properties of the n-type and p-type off-stoichiometric compounds $Fe_{2-x}V_{1+x}Al$ will also be studied.

The nature of the substrate (flexible or not) on which the thermoelectric material will be deposited will also be a crucial point for the integration of modules on non-planar products.



Thermoelectrical device based on bismuth-telluride thin films.

Collaboration: Collaboration with industrial Schneider-Electric

Possible extension as a PhD: Yes

Required skills:

Interest in solid-state physics and experimental physics, characterization techniques. Experience in thin film deposition will be particularly appreciated but not necessary.

Starting date: Spring 2021

Contact:
Daniel Bourgault
Institut Néel - CNRS
Phone: 0 4 76 88 90 31 e-mail : daniel.bourgault@neel.cnrs.fr
More information: http://neel.cnrs.fr