MASTER INTERNSHIP CDM1

2023-2024

Title of the project: Study of cationic substitution in the kesterites phase for eco-compatible and low-cost thin film solar cells.

Étude de la substitution cationique dans la phase kesterites pour des cellules solaires à couche mince éco-compatibles et à faible coût.

Supervisor(s):
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Subject situation:

Today, the use of photovoltaic energy on a large scale requires solar cells (CS) made of abundant and non-toxic materials. Silicon technology dominates the photovoltaic (PV) market with an efficiency of 26.3%, but its manufacturing cost remains high, which limits its use at the terawatt level. The thin-film technology with Kesterite absorbeur (Cu_2ZnSnS_4 named CZTS or $Cu_2ZnSnSe_4$ named CZTSe) based on copper, zinc, tin and sulphide or selenide is promising for the development of environment-friendly solar cells. However, the performance is still weak: 12.6% for $Cu_2ZnSn(S,Se)_4$ and 10% for Cu_2ZnSnS_4.

In our Nanoform team, we produce and optimise full kesterite solar cells using eco-friendly and inexpensive processes and chemical products. Our practical and theoretical works contribute to understanding the origin of the limitation of the efficiency of solar cells based on kesterites. We study, among other things, the effect of cationic substitutions for the overall optimization of the cell with a detailed study of the properties of materials and interfaces.

Objectives of the internship:

The subject of this internship is the realisation and the characterisation of cationic substitution in the kesterite phase. The steps of this work are:

- 1) bibliography study on substituted and unsubstituted CZTS phases, on the synthesis of CZTS layers by chemical way,
- 2) realize the thin layers of CZTS with partial and / or complete substitution of Zn (or Cu or Sn).
- 3) identification of the phases and full characterisation of the phases,
- 4) realisation of the device (full solar cell with all layers)
- 5) characterisation of the kesterite solar cells (efficiency, I/V curve…)

Subject collaborations:

This project will be based on the complementary expertise of i) the Nanofrom team (nanosciences axis, ICB lab.) for the elaboration of kesterite materials, the elaboration of devices by chemical routes (Nanoform Team) ; ii) and technical characterisation departments (ARCEN, ICB teams…) for structural and physicochemical characterizations (XRD, XPS, TEM, SEM EDS…).

Type of project (theory / experiment): Experimental (elaboration, characterization…)

Funding : 3-month scholarship

Location of the internship: This internship will take place at ICB (Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR6303, Dijon)

Required skills in : chemistry and physicochemistry, some knowledge in solid state physics…

And : autonomy, curiosity, practicality