Centre de Nanosciences et de Nanotechnologies

# Soutenance de thèse

**Mardi 16 octobre**

14h00

Institut Photovoltaïque d'Ile-de-France (IPVF)
30 route départementale 128
91120 Palaiseau
Amphithéâtre

## Hung-Ling CHEN

## *« Ultrathin and nanowire-based GaAs solar cells»*

**Jury members :**

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|---|---|---|---|
| Marko TOPIč | Professeur | University of Ljubljana | Rapporteur |
| Nicolas CHAUVIN | Chargé de Recherche | Institut des Nanotechnologies de Lyon | Rapporteur |
| Stéphane COLLIN | Chargé de Recherche | Centre de Nanosciences et de Nanotechnologies | Directeur de thèse |
| Andrea CATTONI | Chargé de Recherche | Centre de Nanosciences et de Nanotechnologies | Examinateur |
| Jean-Jacques GREFFET | Professeur | Institut d'Optique Graduate School | Examinateur |
| Henri MARIETTE | Directeur de Recherche | Institut Néel | Examinateur |
| Oliver HöHN | Researcher | Fraunhofer Institute for Solar Energy Systems ISE | Examinateur |

**Abstract :**

Confining sunlight in a reduced volume of photovoltaic absorber offers new directions for high-efficiency solar cells. This can be achieved using nanophotonic structures for light trapping, or semiconductor nanowires. First, we have designed and fabricated ultrathin (205 nm) GaAs solar cells. Multi-resonant light trapping is achieved with a nanostructured $TiO_2$/Ag back mirror fabricated using nanoimprint lithography, resulting in a high short-circuit current of 24.6 mA/cm². We obtain the record 1 sun efficiency of 19.9%. A detailed loss analysis is carried out and we provide a realistic pathway toward 25% efficiency using only 200 nm-thick GaAs absorber. Second, we investigate the properties of GaAs nanowires grown on Si substrates and we explore their potential as active absorber. High doping is desired in core-shell nanowire solar cells, but the characterization of single nanowires remains challenging. We show that cathodoluminescence (CL) mapping can be used to determine both n-type and p-type doping levels of GaAs with nanometer scale resolution. n-type III-V semiconductor shows characteristic blueshift emission due to the conduction band filling, while p-type semiconductor exhibits redshift emission due to the dominant bandgap narrowing. The generalized Planck's law is used to fit the whole spectra and allows for quantitative doping assessment. We also use CL polarimetry to determine selectively the properties of wurtzite and zincblende phases of single nanowires. Finally, we demonstrate successful GaAs nanowire solar cells. These works open new perspectives for next-generation photovoltaics.

UMR9001 CNRS-UPSUD
Avenue de la Vauve
91120 Palaiseau