Study of selective contacts and p-type connection layers based on indium-free transparent conductive oxides for 2T tandem cells

For the development of new efficient p-type TCO thin films as key step toward transparent electronic, the internship focuses on the development of a p-type oxide thin film material for solar applications.

Context

The evolution of photovoltaics (PV) technologies is critical in addressing global energy challenges by reducing production costs and improving solar cell efficiency. Tandem cells, which utilize multiple materials to capture a broader range of wavelengths from the solar spectrum, have emerged as a promising approach to boost efficiency. However, optimizing selective contacts, which facilitate electron transfer while blocking carrier recombination, is essential for their implementation. Transparent conductive materials (TCMs) play a key role in this context, as they are vital for selective contacts and connection layers that ensure efficient charge collection and transport between different layers of the solar cell. While indium tin oxide (ITO) is widely used as a transparent conductive layer, its scarcity and high cost have spurred the search for alternatives with equal or superior performance. However, the best electrical properties are found in n-type TCMs, while p-type TCMs exhibit lower conductivity and mobility, particularly on thermally sensitive and flexible substrates, which are increasingly important for next-generation PV technologies. This performance gap hinders the development of transparent, hole-conducting thin films and the realization of transparent p-n junctions, which could significantly enhance solar cell performance. To address this, a new class of materials with strongly correlated electron phases has emerged as promising candidates for p-type transparent semiconductors. These materials have the potential to overcome the limitations of traditional p-type oxides, paving the way for efficient, flexible, and transparent solar cells that could revolutionize the future of PV technology.

Project description

Within this context, the internship focuses on the study of the deposition of $LaSrNbO_3$ (LSNO) thin films by metal-organic chemical vapor deposition (MOCVD). The optimization of the growth conditions will be performed by a detailed characterization study using a wide range of standard physicochemical analysis techniques (X-ray diffraction; scanning and transmission electron microscopy; energy and wavelength-dispersive X-ray microanalysis, Fourier-transform infra-red and Raman spectroscopies). Transparent p-n junction devices will be subsequently fabricated by depositing the LSNO films on $SrNbO_3$, one of the best n-type TCOs. The electrical and transport properties will also be analyzed using numerous characterization (Van der pauw method, TLM, capacitance-voltage, KPFM, Hall effect).

Scientific environment:

The candidate will work in the LMGP, Materials and Physical Engineering Laboratory, in the FunSurf team in close collaboration with CROMA in the CMNE team, a specialist in characterization and electrical properties of semiconductors.

Located in the heart of an exceptional scientific environment, LMGP and CROMA offer the candidate a rewarding place to work. LMGP and CROMA website: [LMGP (grenoble-inp.fr)] et [CROMA (grenoble-inp.fr)].

Profile & requested skills:

The candidate is an engineering school and / or Master 2 student whose training focuses primarily on materials science. Aptitude for teamwork, good spoken and written English will be appreciated. We are looking for a dynamic, motivated and autonomous student. Thesis continuation possible.

Internship allowance : Internship allowance will be provided.

Duration : 5 – 6 months.

Application Deadline : 30 November 2024

CONTACT

Jean-Luc Deschanvres: jean-luc.deschanvres@grenoble-inp.fr; Tel: 04 56 52 93 34

Frederique Ducroquet: frederique.ducroquet@grenoble-inp.fr; Tel: 04 56 52 95 24

Johnny Azzi: johnny.azzi@grenoble-inp.fr