Centre de Nanosciences et de Nanotechnologies

Soutenance de thèse

Mercredi 13 juillet
14h00
Amphithéâtre

«Understand and overcome the limitations of silicon/amorphous silicon (a-Si:H) nanowire solar cells»

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Link: https://cnrs.zoom.us/j/96292459096?pwd=Q0JxcGx1MW9BTk9Hcm1KQUkrbE52dz09
Passcode: HCqyW4

Jury members :

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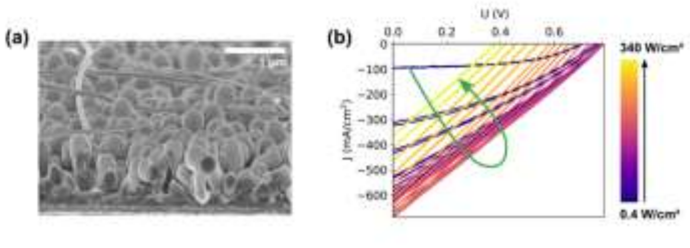
Abstract :
Among different materials for photovoltaic conversion, hydrogenated amorphous silicon (a-Si:H) displays excellent optical properties and can be used as a thin-film, requiring less material. However, the low mobilities of its charge carriers limit the efficiency in planar solar cells. Core-shell structures can solve this issue. This PhD work focuses on solar cells made of silicon/amorphous silicon (a-Si:H) core-shell nanowires (NWs). For these nanostructures the optimization of the top contact, which has to be both transparent and conductive is a major challenge. We developed a hybrid electrode, made of ITO and silver nanowires, to efficiently collect the charge carriers from every nanowire and over the whole cell (Fig. (a)). Changing the illumination level, we optimized the electrode transparency and conductivity directly on the device. The hybrid electrode increased the power conversion efficiency from 4.3 % to 6.6 % compared to the reference ITO electrode. In addition, we studied the change in performance of Si NW/a-Si:H solar cell under strong illumination (Fig. (b)). Amorphous silicon is generally believed to be suited only for low illumination levels, but there are no detailed studies on this topic, especially in a core-shell NW solar cell architecture. The comparison of I-V measurements of a Si NW/a-Si:H with a planar a-Si:H and a crystalline silicon solar cells evidenced different phenomena, both reversible and irreversible. In particular, it showed that the first limiting factors are not directly related to a-Si:H, but to the top-contact and the substrate.



(a) Cross-section SEM image of Si NW/a-Si:H with a hybrid electrode made of ITO and Ag NWs.
(b) I-V measurements under very strong illumination of a Si NW/a-Si:H solar cell (532 nm).

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