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## **Adding functionality to cellulose thin films for photovoltaic applications**

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Cellulose nanofibrils (CNF) as a bio-based material are very attractive due to their resource-saving and renewable properties. They are biocompatible, flexible, lightweight, transparent, and show excellent mechanical strength. By adding functional properties, they can be used as base material for incorporating photovoltaic or electronic devices in a CNF-based composite material. We are aiming for building integrated photovoltaics. Solar cells with PEDOT:PSS as electron blocking layer, P3HT:PCBM as photoactive layer, and ZnO as hole blocking layer will be designed both in standard and inverted architecture directly deposited on a CNF composite. A CNF / Ag nanowires mixture can be used as electrode material to improve the conductivity of the Ag nanowire network as electrode. Spray deposition will be used as a suitable technique to fabricate such functional layers on a large scale with homogeneous surface and a low roughness. In-situ grazing incidence small- and wide-angle X-ray scattering (GISAXS/GIWAXS) will be used to observe the nanostructuring of each layer on the CNF composite material and to optimize the fabrication process.

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