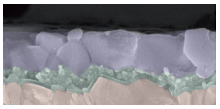

More efficient peroskite solar cells by inserting metallic nanoparticles

In order to offset the exit from fossil fuels, the development of renewable energies is a crucial issue - coupled of course with a reduction in our energy consumption. In the field of photovoltaic solar energy, the new materials of the perovskite family show encouraging performances. They can be deposited by relatively simpler and more economical processes than the silicon currently used. Many ongoing studies aim to control their large-scale deposition and their stability (aging, temperature) without reducing their light absorption and charge generation properties. Nanostructures and Optics team from the INSP collaborated with the Institut de Recherche de Chimie Paris to analyze how the absorption of light by a perovskite cell was modified by the addition of metallic nanoparticles.

The INSP's team «Nanostructures and Optics» is interested in nanophotonic or plasmonic mechanisms by which the absorption or emission of light by a material can be favored near nanometric patterns. In order to analyze how these mechanisms can be applied to the photovoltaic field, we studied solar cells fabricated at the Institut de Recherche de Chimie Paris (IRCP) by integrating metallic nanoparticles (14 nm gold spheres) into the photovoltaic perovskite layer.
The obtained experimental devices showed a relative increase in photovoltaic efficiency of 12%, which is significant in a market where each additional percent of efficiency represents colossal sums. This gain is due to better light absorption, especially in the 650-800 nm spectral range (red light).
Based on our previous work on modeling the absorption of light by perovskite cells [1], we have theoretically shown that this effect cannot be linked to a nanophotonic effect because the concentration of nanoparticles is not sufficient. On the other hand, we have shown, by an analysis of the composition as a function of the position, that the presence of the nanoparticles made it possible to grow a perovskite layer of better crystalline quality, with fewer defects and fewer energy losses, which explains the efficiency gain observed [2].

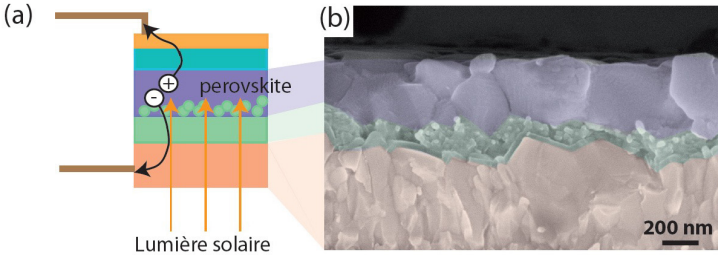

Figure 1
(a) Diagram of a perovskite cell. The light is absorbed by the perovskite layer, giving rise to charges evacuated by two electrodes at the top and bottom. (b) Scanning electron microscopy image of the perovskite cell (after the perovskite layer deposition stage: the upper layers are not yet deposited).

Ongoing work, still in collaboration with the IRCP, will establish under which conditions gold nanoparticles make it possible to make the most of the effects of nanophotonics and enhance light absorption in perovskite solar cells.

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[2] "How do gold nanoparticles boost the performance of perovskite solar cells?"
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