PlasMORE-LIGHT ANR Project: Broad band tunable Plasmonic MOlecular REctennas to produce electricity from LIGHT

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Current PV technologies do not allow to convert the whole solar spectrum into electricity, and most of light and flexible PV systems exhibit limited power conversion efficiency, typically around 20%. Indeed, PV devices exploit the particle nature of light and the working spectral range of a PV device is limited by its band gap, which is an intrinsic property of the semiconducting material.

We explore a new paradigm, coming from the microwave community, in which the wave property of light is exploited to convert free-propagating electromagnetic waves at optical frequencies to direct current. We investigate optical rectennas composed of plasmonic nano-antennas associated with rectifying diodes to directly convert light into electricity [1, 2]. This technology presents two main advantages. The first one comes from the ability to convert electromagnetic waves into electricity from far infrared to the visible range with high-power conversion efficiency (PCE). The second advantage is related to the possibility of tuning the rectenna working spectral range to optimize PCE for any light source by simply adjusting the antenna geometry.

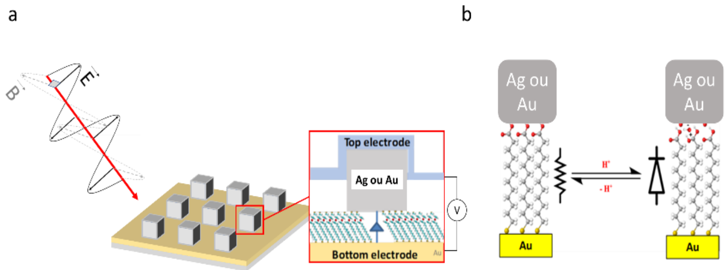

Figure 2 a- schematic representation of the rectenna proposed architecture and b- switchable SAM terminated by carboxilic acid groups (extracted from Y. Ai et al., Nano Lett., 18, 12 7552-7559,

Our research efforts have resulted in the fabrication of nanopatch antennas able to couple resonant gap plasmon in nano-cavities and constructed from silver nanocubes using a bottom-up approach. These nano-patch antennas are associated with high frequency molecular diodes to convert electromagnetic waves at optical frequencies (c.f. figure 1a-). We will present the **PlasMORE-LIGHT** ANR project which proposes to study **a breakthrough concept of wavelength-tunable rectennas** aiming at converting light into electricity from visible to infrared (c.f. figure 1a- and 1b-).. We propose an approach allowing studying the **interplay between nano-scale molecular electronics and plasmonics** and the development of **new functional nanostructured materials for energy harvesting**. To reach these objectives, this project combines strong skills and expertises of four laboratories (IM2NP, CINaM, IEMN and ICR) in different domains including **multi-physic modeling, molecular diodes, nano-antenna fabrication, organic chemistry, functional material synthesis, and advanced nano-scale and macroscopic characterizations**.

[1] D Duche, L Escoubas, U Palanchoke, JJ Simon, TS Balaban, patent EP 3 493 283 A1 (2017) / US Patent App. 16/762,126 (2020)

[2] C.A. Reynaud, D. Duché et al., Progress in Quantum Electronics, 100265, (2020).