## Transport in photoelectrochemical heterojunctions: Interface-controlled physics

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Widely investigated in the 70's and 80's, photo-electrochemistry of semiconductors (SC-PEC) has regained a huge interest in the context of global warming, especially with the quest of solar fuel production. Considerable advances have indeed been made from those days to understand and tailor the physics of semiconductor photoelectrodes, with the development of protection and catalytic coatings for aqueous operation, [1] and the development of novel electrochemical schemes such as photo-induced electrochemiluminescence. [2]

Compared to photovoltaics where solar spectrum harvesting and carrier transport are the main challenges, PEC devices also require the management of the electrolyte/SC interface. In most photoelectrodes, this Schottky-like interface is the heart of the device, enabling to feed the electrolyte with the ad-hoc photo-carrier, depending on the intended chemical reaction. Still, it is also the place where harmful effects can appear such as surface trapping and corrosion. Engineering of this interface is thus crucial in view of chemical stability, photovoltage and overpotential optimization.

In this talk, we will first introduce the basics of SC photo-electrodes, emphasizing on the conceptual gaps between experiments and numerical simulations of the devices. This will allow us to address the concept of III-V thin films on silicon for PEC where the physics of the device not only depends on the electrolyte/III-V interface but also on the III-V/silicon one and on structural defects with semi-metal properties which cross the III-V layer.[3] These novel heterojunctions show promising performances at both poles of PEC cells for solar hydrogen production (see Figure 1).

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Figure 1: Sketch of a solar hydrogen production cell composed of both a GaAs/Si photocathode for water reduction into  $H_2$  and a GaPSb/Si photoanode for water oxidation into  $O_2$ .

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