

III – V core / oxide shell nanowires for light – driven water splitting

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Photoelectrochemical cells (PEC) are one of the most promising approaches for the production of alternative energy carrier in the global effort to diminish the usage of fossil fuels [1]. In this context, III-V nanowires (NWs) based photoelectrodes [2, 3] are particularly attractive thanks to their high surface/volume ratio, efficient charge separation and collection and their light trapping potential. However, III-V NWs suffer from corrosion in aqueous electrolyte, which prevents their utilization for a long period. In order to avoid the surface degradation of the NWs under working conditions, a particular attention has to be given to their surfaces. We proposed to grow an oxide shell, transparent to visible light and compatible with the carrier transfer from the III-V semiconductor to the electrolyte, to increase the viability of these photoelectrodes.

GaAs NWs were grown by molecular beam epitaxy (MBE) using the vapor-liquid-solid (VLS) mechanism on silicon substrate [4, 5], and a TiO₂ shell was deposited by atomic layer deposition (ALD). The morphology, and interface of the NWs were studied by scanning transmission electron microscopy and electron energy-loss spectroscopy. Measurements performed on the PEC revealed an enhancement of the photoactivity by a factor 20 comparing a thin layer of GaAs and optimized GaAs NWs, reaching a current density of around 1.2 mA/cm² at 0.0 V vs RHE [6].

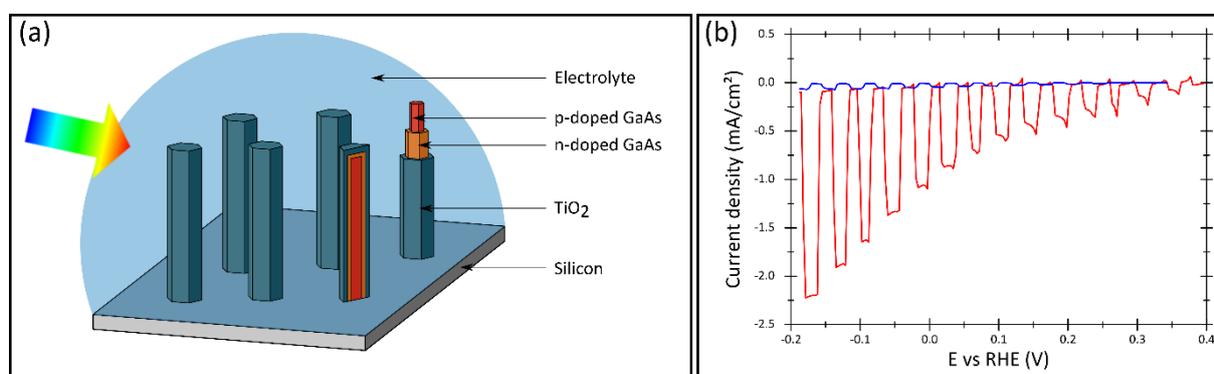


Figure 1 (a) Schematic representation of the photoelectrochemical cell. (b) Linear sweep voltammogram measurements comparing the photoactivity of a 2D layer of GaAs (blue curve) and GaAs NWs (red curve).

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