# Determination of band alignment at GaN passivation layer and GaInP(100) heterointerface

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Up to date, III-V semiconductor-based tandem devices with GaInP top photoabsorbers show the highest solar-to-electricity or solar-to-fuel conversion efficiencies. In PEC cells, however, III-V semiconductors are not stable against photochemical corrosion, and so they need suitable functional layers for electronic and chemical passivation as for example GaN films. The band alignment between such a protection layer and the III-V semiconductor should be aligned to minimize corrosion, non-radiative interfacial recombination and to promote selective charge carrier transport. We investigate the band alignment between GaN passivation layers and n-type doped GaInP(100) photoabsorbers and grew n-type GaInP(100) epitaxially by metalorganic chemical vapor deposition on oxidized GaAs(100) substrates in order to mimic a realistic preparation sequence. We prepared 1 – 20 nm GaN films on top employing atomic layer deposition and studied the band alignment at the GaN/ GaInP(100) heterointerface by X-ray and ultraviolet photoelectron spectroscopy. Due to the limited emission depth of photoelectrons, we determined the band alignment by a series of measurements, in which we increased the thickness of the GaN films successively. In addition, we varied different well-defined GaInP(100) surface reconstructions. As a result, the n-GaInP(100) surfaces, prepared with a well-known phosphorus-terminated p(2x2)/c(4x2) reconstructions show upward surface band bending (BB) of 0.38 eV, and a Fermi level pinning due to the presence of surface states. Upon oxidation, the surface states are partially passivated resulting in a reduction of the BB to 0.16 eV and a valence band offset (VBO) between the GaInP(100) and the thin oxide layer of 2.01 eV. Applying Kraut's approach, we identified a VBO of 1.90 eV and a conduction band offset of 0.44 eV between GaInP(100) with a thin oxide layer and the GaN passivation layer. We conclude that GaN is a well-suited passivation layer for PEC cells and facilitates selective transport of photogenerated electrons.