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Interface chemistry of Al$_2$O$_3$/III-V upon atomic layer deposition

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The atomic layer deposition of Al$_2$O$_3$ films on III-V semiconductors induces the reduction of native oxides on III-V surfaces [1]. Although this behaviour has been widely investigated [2,3], details of the mechanisms leading to the interface formation and their chemical/physical properties (roughness, chemical composition, and defect density) is still matter of investigations [4,5]. In this contribution we present a detailed study of the growth of Al$_2$O$_3$ by tri-methyl-Al (TMA) on various III-V substrates (InP, GaAs, InAlAs) by means of in-situ synchrotron radiation-photoelectron spectroscopy (SR-PES), measured at BESSY-II, Berlin. Due to the high resolution of SR-PES, we can determine the chemical composition of III-V surfaces before treatment (native oxide covered), after the ex-situ pre-treatment, i.e. cleaning with either (NH$_4$)$_2$S, H$_2$(SO$_4$) or NH$_4$OH, and after each TMA half cycle. The final Al$_2$O$_3$/III-V chemistry shows differences depending on III-V semiconductor and on surface pre-treatment. Electrical characterization and in-situ valence band measurements showed only small unpinning effects due to the reduction of native oxide.

References