Dynamic Oxidation of Gallium Phosphide Surface Tracked by Near Ambient Pressure XPS

SYLWIA PTASINSKA, XUEQIANG ZHANG, University of Notre Dame — Both from applied and fundamental points of view, it is important that we have a detailed molecular-level understanding of gas-solid interface interactions, especially under operational conditions. Recent progress in in-situ instrumentations (e.g., Near Ambient Pressure X-ray Photoelectron Spectroscopy—NAP XPS), has enabled us to explore the physicochemical processes at the gas-solid interface over a varied range of pressures (up to mbar range), bridging the gap in our knowledge of interfacial interactions. Our recent investigations have focused on dissociative adsorption of small gas-phase molecules onto III-V semiconductors, which leads to surface oxidation. In this work, we carried out a pressure- and temperature-dependent study of GaP(111) oxidation in an O$_2$ environment. Dynamic changes in chemical evolutions at the O$_2$/GaP(111) interface were reflected in Ga 2p$_{3/2}$, O 1s, and P 2p spectra. Different oxidation states were observed, involving Ga$_2$O, Ga$_2$O$_3$ and GaPO$_4$ formation. A “phase diagram” of GaP(111) oxidation under various O$_2$ pressures and temperatures can help us visualize transition states and gain more insights into chemical pathways leading to the final products of GaP oxidation. Further, an estimation of work function changes of the oxidized GaP surface was obtained under near ambient conditions.

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