Self-Assembly of Phosphonate-based Monolayers on GaAs and GaN

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Monolayers of organic molecules on surfaces can be used for a variety of interesting processes such as soft lithography, surface passivation, alteration of work function, and the interfacing of surfaces for biological or soft materials. Typically, these have been demonstrated using systems such as alkanethiol monolayers on gold. Relatively little has been shown involving the formation of monolayers on III-V semiconductors with the exception some work involving the use of alkanethiol monolayers for electron-beam resists on GaAs.[1] We have examined the formation of both thiol-based on both GaAs and GaN and compared these monolayers to those formed by octadecylphosphonic acid (OPA) and other phosphonate-terminated molecules. Evidence of monolayer formation was found using contact angle measurements and X-ray photoelectron spectroscopy. The phosphonate-based monolayers were found to be stable over the period of weeks in comparison to the previously reported hours to days lifetime of the thiol-based monolayers. It is believed that this is due to the fact that a phosphonate forms bonds to the surface with two oxygen atoms rather than the single sulfur atom of the thiol molecule. The possible uses of these monolayers for the processing of these materials will be discussed.

[1] R. C. Tiberio, et al., Appl. Phys. Lett. 62 (5), 476-478 (1993).