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Tailoring Oxide-Semiconductor Interfaces – an enabling sub-nano approach for new science and advanced devices

Minghwei Hong

Department of Materials Science and Engineering, National Tsing Hua University, HsinChu, 300, Taiwan, R.O.C.

In the past few years, ultra-high vacuum deposited amorphous $Ga_2O_3(Gd_2O_3)$ and single crystal Gd_2O_3 have been discovered to unpin the Fermi level of compound semiconductor surfaces, an accomplishment sought after for the last forty years. Having understood the mechanism, we have now found Al_2O_3 prepared by a non-UHV method for achieving similar results. More recently, high-quality nano-thickness Al_2O_3 and Sc_2O_3 were found to epitaxially grow on Si, despite a huge lattice mismatch of 10%. Consequently, single crystal GaN was grown on these thin oxide single crystal.

Our approach enables us to explore new frontiers in nano-science and at the same time to develop novel nano-technologies. The uniqueness in our method is our ability in controlling, in atomic scale, the oxide/semiconductor interfaces. The achievements on materials science, physics, and device performance are reviewed. New results and the challenges are presented.

E-Mail: mhong@mse.nthu.edu.tw

http://mse.nthu.edu.tw/~mhong/