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Scanning Tunneling Microscopy and Spectroscopy of Semiconductor Surfaces[1]

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We discuss recent advances in our knowledge of the structure, electronic spectroscopy, and transport properties of semiconductors, obtained primarily through measurement with the scanning tunneling microscope (STM). For the wide band gap materials GaN and AlGaN, observation of various reconstructions together with first-principles theory have enabled the determination of many of the fundamental surface structures. The occurrence of incommensurate metallic layers on the surfaces, and their relevance for growth and control of thin film properties, will be described. Heterostructures of InGaP/GaAs have been studied in cross-section, permitting determination of the band offset between these materials. Detailed electrostatic simulations of the influence of the STM probe-tip on the measurement are used to provide an error bound on the result. Finally, for both Ge and SiC, spectroscopic measurements as a function of current reveal transport limitations in the conductance through surface states. Extension of the results to the determination of transport properties of other surfaces will be discussed.

[1]Work performed with Y. Dong, C. D. Lee, J.E. Northrup, J. Neugebauer, V. Ramachandran, G. Meyer, K.-H. Rieder, M.P. Semtsiv, and W.T. Masselink, and supported by NSF and ONR.