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UHV Nanoworkbench and the 'Roaming' Field Effect Transistor

OLIVIER GUISE, JOHN T. YATES, JR., Surface Science Center, Center for Oxide Semiconductor Materials for Quantum Computation, Dept of Chem., Univ. of Pittsburgh, JOACHIM AHNER, Seagate Technology, JEREMY LEVY, Surface Science Center, Center for Oxide Semiconductor Materials for Quantum Computation, Dept of Physics and Astronomy, Univ. of Pittsburgh — A multiple-tip ultra-high vacuum (UHV) scanning tunneling microscope combined with a scanning electron microscope (SEM) and molecular-beam epitaxy growth capabilities has been developed. This instrument (Nanoworkbench - NWB) is used to perform four-point probe conductivity measurements at sub-micrometer spatial dimension. The system is composed of four chambers, the multiple-tip STM/SEM chamber, a surface analysis and preparation chamber equipped with standard surface science tools, a molecular-beam epitaxy chamber and a load-lock chamber. The four chambers are interconnected by a unique transfer system based on a sample box with integrated heating and temperature-measuring capabilities. We demonstrate the operation and the performance of the NWB with four-point- probe conductivity measurements on a silicon-on-insulator (SOI) crystal. The creation of a 'roaming' Field-Effect Transistor, whose dimension and localization are respectively determined by the spacing between the four probes and their position on the SOI surface, is demonstrated. The NWB has a potential to look at nanostructures developed in situ using the MBE chamber, such as Ge quantum dots for example. This work was supported by DARPA QuIST through ARO contract number DAAD-19-01-1-0650.

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