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Probing electronic transport in SiO2 films containing Si nanocrystals by conductive atomic force microscopy TAO FENG, HARRY ATWATER, California Institute of Technology — Understanding the mechanisms of charge injection into Si nancrystals embedded in SiO2 is the central issue governing device performance in Si nanocrystal nonvolatile memories. We use conductive atomic force microscopy (c-AFM) to study transport in partially etched SiO2 films containing Si nanocrystals fabricated by Si ion-implantation into a 15 nm SiO2 layer on p-Si (001). The 2∼3 nm size nanocrystals were identified by scanning tunneling microscopy. In the c-AFM experiments, correlation between morphologies and tunneling current images shows dependence of tunneling currents on SiO2 thickness fluctuation. Highly localized tunneling paths were recorded and attributed to localized state-assisted tunneling through nanocrystals and/or defects. The electron tunneling current changes much more rapidly with SiO2 thickness than the hole tunneling current, a result explained by the combination of Fowler-Nordheim tunneling and inversion layer formation in the channel for electron tunneling. Current-voltage spectroscopy data showing resonant tunneling and itinerant single electron storage will be presented and discussed.

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