AN 451

Accurate Thin Film Measurements by High-Resolution Transmission Electron Microscopy (HRTEM)

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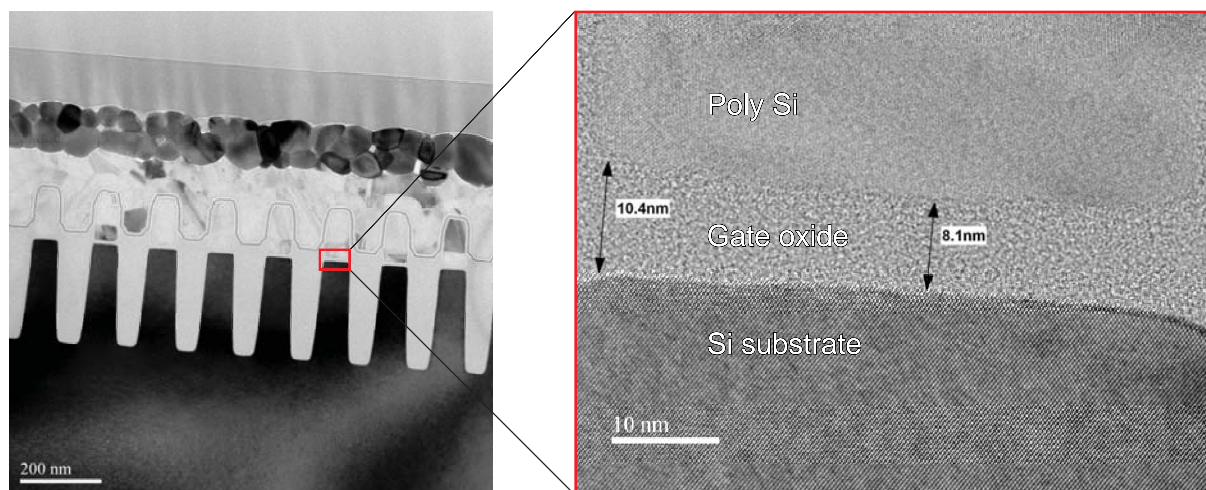
Discussion

High-Resolution Transmission Electron Microscopy (HRTEM) is often used to make quantitative measurements of nm scale features due to its outstanding image resolution (< 2 Å), its ease of calibration, and high precision and accuracy. Below are images of a commercially available solid state memory device. The images show both a wide field of view and high resolution image of a region of interest near the gate oxide. Individual columns of silicon atoms are evident in the high magnification image, which are used to calibrate the measurement of the thin film. These columns of atoms are often observed in single crystal materials, while in polycrystalline materials "lattice fringes" are commonly observed and can be used for calibration as well. When characterizing samples that do not display columns of atoms or lattice fringes, the excellent stability and reproducibility of the TEM allows accurate measurements using an external calibration. Note the excellent strong contrast between the crystalline Si, the gate oxide and the poly Si. TEM is an excellent tool for the characterization of complex structures to determine film thickness, material crystallinity, film integrity, film roughness, coverage and for the observation of the shape of nanoscale structures.



Figures 1 & 2. Low magnification (left) and high magnification images (right) of a flash memory device. The image on the right indicates the dimensions of the gate oxide.

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