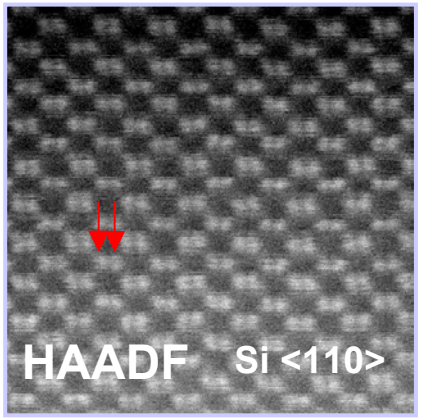
Acquisition of a Field Emission Transmission Electron Microscope

James S. Speck, University of California, Santa Barbara

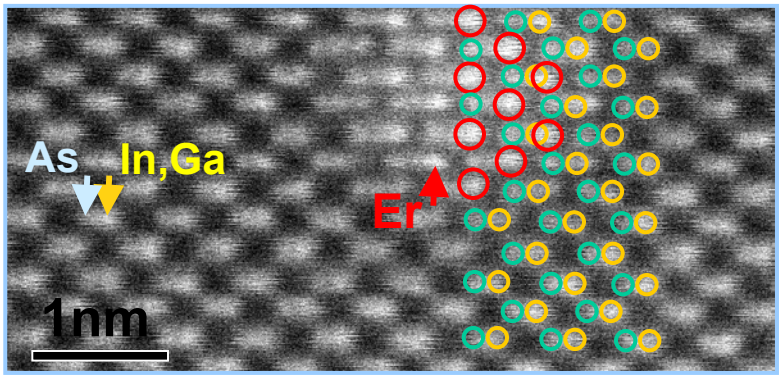
DMR-0216466

Tecnai F30

- 300 kV field emission
- UTwin lens
- Enfina PEELS
- 2k x 2k CCD
- HAADF detectors
- EDS



Silicon Dumbbells (arrow spacing ~ 0.139 nm) are resolved in high-angle annular dark-field imaging or Z-contrast



Growth direction Er In, Ga As

- STEM Z-contrast image that directly shows (without the need for image simulations) that ErAs particles epitaxially grown in an InGaAs matrix have rocksalt structure and that the As sublattice is continuous across the interface
- The particles (~ 1nm in size) overlap with the matrix and the crystal structure could not have been identified by conventional high-resolution TEM

The new field emission TEM allows atomic resolution scanning transmission electron microscopy techniques, such as imaging with strong atomic number (Z) sensitivity. “Z-contrast” imaging is used in numerous current research projects in electronic, inorganic, and structural materials that involve materials inherently complex in structure and chemistry. The electron energy-loss spectrometer allows sub-nanometer compositional and bonding information.

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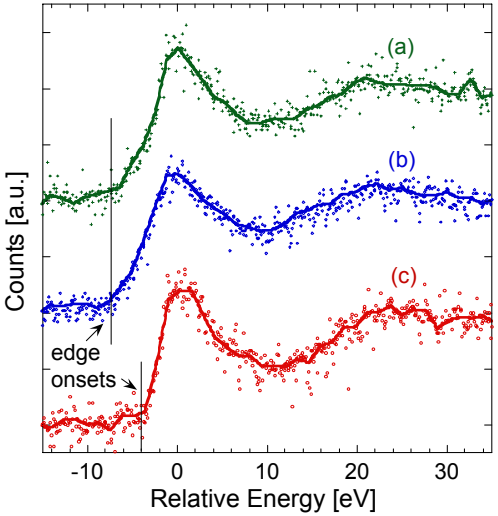
Education:
The new instrument has become the main research tool for a number of M.S. and Ph.D. students. As part of the project, two new graduate courses have been developed:
•"Transmission Electron Microscopy of Soft Materials" (Spring 2002)
• "Advanced Transmission Electron Microscopy" (Fall 2004).

Furthermore, a newly developed TEM lab course (Electron Microscopy I: Principles and Practice) will use the new field-emission TEM in practical sessions.

Electron energy-loss spectra (O K-edges) of thin interfacial SiO_2 layers acquired by Ph.D. student Ms. Melody Agustin as part of her doctoral work.