

Advances in understanding of fundamental phenomena in low dimensional semiconductor structures by *in-situ* TEM

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In this presentation we summarize our contributions to the understanding of dynamic process in low dimensional semiconductor structures (thin films and quantum dots). The main emphases of this work have been understanding and quantifying strain relaxation phenomena in heteroepitaxial growth, correlating structural changes to semiconductor device performance, and understanding fundamental phenomena in guided growth of semiconductor quantum dots on locally modified surfaces.

Major themes of this work include:

- 1) Use of *in-situ* TEM to accurately quantify dynamic phenomena (e.g. misfit dislocation propagation rates).
- 2) New insight into nano-scale / atomic-scale phenomena (e.g. kink generation in dislocations, nucleation of semiconductor quantum dots)
- 3) Nanoscale measurements of local strain, using local dislocation velocities as a “strain gauge”
- 4) Correlation of structure/chemistry to electrical and optical properties, and ultimately to device performance.
- 5) Highly accurate measurement of experimental conditions (temperature, input fluxes, samples stress states)
- 6) Application of multiple stimuli to the sample (e.g. thermal/electrical/optical)

This work is done in collaboration with Chi Chin Wu, John Bean (UVa), Eric Stach (Purdue), Frances Ross (IBM), David Mathes (Honeywell), Kent Choquette (UIUC)