Yale Institute for Nanoscience and Quantum Engineering

Friday- December 14, 2012

12:00 to 1:00 p.m.

Becton Seminar Room

Light lunch will be served at 11:45 a.m.

Benjamin Leung

School of Engineering and Applied Science, Yale University

"Unifying epitaxial growth and microfabrication processes for GaN semiconductor material and devices"

The foundation of compound semiconductor technology is in epitaxial growth processes, such as molecular beam epitaxy and metalorganic chemical vapor deposition. In these techniques, controlled deposition of thin films suitable for electronic and optoelectronic devices are typically performed in planar geometries, where the atomic arrangement of growing layers are dictated by the existing template. This has been the basis for production of III-V semiconductor device material of suitable crystalline perfection to be used in high efficiency solar cells, high-speed and high-power transistors, and light-emitting diodes.

In this talk, a different paradigm of crystal growth is explored, involving the integral use of microfabrication processes. Here, the MOCVD growth of GaN is extended by the use of selective area growth, where the area of crystal growth can be pre-defined by the modification of the planar surface used as a template. This is shown by the preparation of single-crystalline GaN layers on an amorphous surface by the use of a vertically and laterally confined dielectric 'tunnel mask'.

Menno Poot

School of Engineering and Applied Science, Yale University

"Squeezing in a strongly coupled opto-electromechanical resonator"

Parametric squeezing can reduce the uncertainty in one quadrature of the position of a mechanical resonator, even below the standard quantum limit, and it can improve measurement sensitivity. Here we demonstrate squeezing of the thermal motion of a 570 kHz opto-electromechanical resonator made out of high-stress SiN by modulating its spring constant at twice the resonance frequency. Parametric and direct actuation are achieved by applying a.c. voltages between strongly coupled electrodes: one on the resonator and a fixed one. It is well know that using this method the motion of a single quadrature cannot be decreased more than 3 dB below the undriven case before instabilities kick in. However, by measuring the phase-space trajectory of the resonator and adjusting the phase of the parametric drive in real-time we achieve a stationary reduction in both quadratures that is far beyond this limit. Another important feature of our design is that, due to the strong coupling between the drive electrodes the frequency can be tuned over a large range using the electrostatic spring effect and the Duffing nonlinearity of the resonator varied all the way from a stiffening spring to a softening one.

HOST: Mark Reed