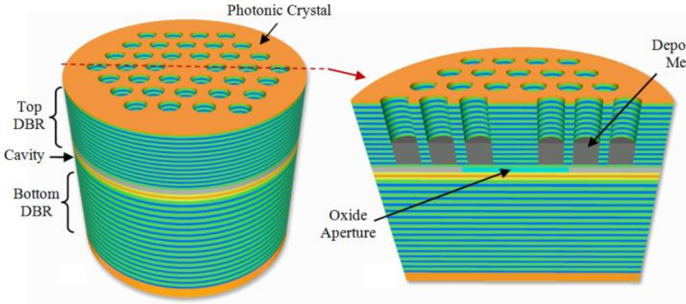
NANOHOUR

Wednesday, February 22, 2012 3:00 pm
Beckman Institute - Room 3269

Mode Suppression in Metal Filled Photonic Crystal Vertical Cavity Lasers

Ben Griffin, Electrical and Computer Engineering

Graduate Student with Professor Lynford Goddard

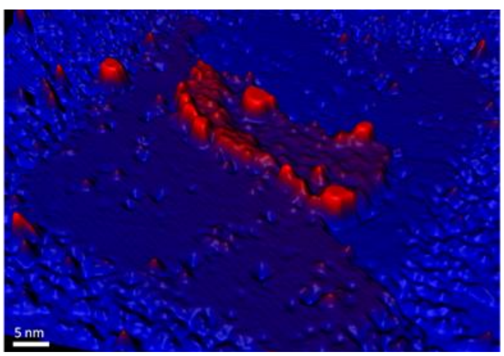


It has been shown in literature by a variety of groups that enabling single-mode operation in vertical-cavity surface-emitting lasers (VCSELs) can be accomplished by periodically etching air holes in the top reflector to form a photonic crystal (PhC) surrounding a central defect, in which the mode is confined. Single-mode lasers with a large side mode suppression ratio (SMSR) are important for a variety of applications including optical communication networks, short-range optical interconnects, optical storage, and sensing. It is important to maximize this SMSR to provide enhancements to communication networks including lower mode partition noise which leads to a lower bit error rate. Simulation results for a PhC VCSEL structure with various thicknesses of metals deposited inside the holes are presented. The higher-order modes of the structure are more spread out than the fundamental mode, and penetrate into the metal-filled holes. Due to the lossy nature of the metal, these higher-order modes experience a greater loss than the fundamental mode, resulting in an enhanced SMSR. A figure of merit for determining which metals would have the greatest impact on the SMSR is derived and validated using a transmission matrix method calculation. A full three-dimensional simulation of the PhC VCSEL structure is performed using the plane wave admittance method, and SMSRs are calculated for increasing metal thicknesses. These simulation models are then validated by experimentally derived results on a fabricated PhC VCSEL with a layer of chromium deposited on the top surface. The simulation and experimental results show an enhanced SMSR of up to 4 dB.

Scanning Tunneling Microscopy Characterization of Graphene Interfaces

Kevin He, Electrical and Computer Engineering

Graduate Student with Professor Joseph Lyding



3D rendering of an UHV-STM image of a modified monolayer graphene nano-flake on the hydrogen-passivated Si(100) surface.

Graphene is a material with impressive electronic and thermal properties, winning the 2010 Nobel Prize in Physics for its myriad of possible applications, both in electronics and beyond. However, many aspects of graphene are still not well understood, and this includes its interactions with various substrates. As a 2D material, many of graphene's properties are directly influenced by the substrate on which it rests, and gaining a better understanding of these interactions is an important step to realizing practical applications for graphene. We use an ultra-high vacuum scanning tunneling microscope (UHV-STM) to characterize the interface between monolayer graphene and several semiconducting and insulating substrates at room temperature. We also use the STM tip to modify the interfaces at the nanoscale as well as trap volatile substances at the interface for characterization.

Coffee and cookies will be served

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