Engineered Quantum Dots for Infrared Photodetector

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Friday July 29th 2011, 1:00 pm,
Birck Nanotechnology Center, Room 2001

Abstract: Quantum dot infrared photodetectors (QDIP) are emerging as a competitive technology for infrared detection and imaging especially in the midwave infrared (MWIR) and longwave infrared (LWIR) regime. These detectors are based on intersubband transitions in self-assembled InAs quantum dots (QDs) and offer several advantages such as normal incidence detection, low dark currents and high operating temperatures, while enjoying all the benefits of a mature GaAs fabrication technology. However, due to Stranski-Krastanov (SK) growth mode and the subsequent capping growth, the conventional SK QDs with pancake shape, small height to base aspect ratio and interface diffusion can not fully exploit the 3D "artificial atom" properties. The speaker will discuss both of the selective capping techniques of Stranski-Krastanov QDs and the optimized growth technology of Sub-Monolayer QDs in Molecular Beam Epitaxy (MBE) growth to engineer the dot geometry and 3D quantum confinement. The speaker has demonstrated the increased dot height to base aspect ratio as 8nm/6nm, enhanced s-to-p polarized spectral response ratio as 37%, strong 3D quantum confinement, bound-to-bound intersubband transition at 10 μm, and improved QDIP characterization such as: highest operating temperature as 250K, photodetectivity as 1×10^{9} $cmHz^{1/2}/W$ and photoconductive gain as 100. The implications of this work and future directions will be discussed.

Biography: Jiayi Shao is currently a Ph.D. Graduate Student and the Research Assistant at the Center for High Technology Materials, The University of New Mexico. She received the B.E. degree in electrical engineering from the Beijing Polytechnic University, Beijing, P. R. China, in 1996, and the M.S. degree in electrical and computer engineering from the University of New Mexico, Albuquerque, in 2006.
Her current interests include design, crystal growth, characterization, processing and testing of III-V/Arsenide semiconductor materials and devices as well as the Quantum-Dot-in-a-Well (DWELL) structure for integration in the mid-wave infrared photodetector (MWIR, 3-5 μm) and long wave Infrared Photodetectors (LWIR, 8-12μm).

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