

# Xifeng Qian

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## PROFESSIONAL PROFILE

In-depth knowledge of photonic devices. Extensive experience in structure design, epi-growth, material characterization, wafer fabrication, and device testing of III-V semiconductor optical devices. Hand-on experience on nano-fabrication/processing. Strong problem solving skills. Highly self-motivated, good communication skills and team work oriented.

## TECHNICAL SKILLS

- Modeling of quantum devices with COMSOL FEMLAB. Extensive experience in modeling/control with LabVIEW, and in data analyzing with Origin.
- Extensive experience in solid source Molecular Beam Epitaxy (MBE) growth of III-V materials.
- Hands-on experience in semiconductor processing and manufacturing techniques: photolithography, nanosphere lithography (NSL), wet chemical etching, mask aligning, E-Beam evaporation, thermal evaporation, plasma-enhanced chemical vapor deposition (PECVD), Bromine-ion beam assisted etching (Br-IBAE), reactive ion etching (RIE), rapid thermal annealing (RTA), wafer polishing, O<sub>2</sub> plasma ashing, and wafer bonding.
- Hands-on experience in semiconductor measurements and characterization techniques: surface profiler, microscope, ellipsometer; nano-mechanical analyzer, optical profiler; Dual beam focused ion beam and scanning electron microscope (FIB & SEM), Energy-dispersive X-ray spectroscopy (EDAX), transmission electron microscopy (TEM), and atomic force microscope (AFM).
- Hands-on experience in optical and electronic characterizations using photoluminescence (PL), Fourier transform Infrared spectroscopy (FTIR), L-I-V measurement, and Hall measurement.

## EXPERIENCE

### 1. Research Assistant, University of Massachusetts at Lowell

2003 - 2009

- Designed and modeled cylindrical and conic InGaAs quantum dot (QD) structure for long wavelength lasers and detectors using COMSOL FEMLAB. Designed InAs quantum dots infrared photodetectors (QDIPs) and InAs QD emitters.
- Developed growth recipes and grew high quality InAs QDs and novel InAs/InGaAs quantum dot-in-well (DWELL) to fabricate QDIPs and focal plane arrays (FPA). Performed structure characterization with AFM. Developed growth recipes and grew high power GaAs/AlGaAs terahertz quantum cascade working lasers (first US academic group demonstrated capability of growing working THz QCLs) and other InAlGaAs epi-structures using Veeco GenII MBE system; Assisted in growing In(Al)GaAsSb long wavelength devices on GaAs, GaSb and InSb substrates and Sb based nBn detectors using Riber 3200 MBE system.
- Troubleshoot and maintained Veeco GenII MBE system (effusion cell power supplies, cryo-pumps, ion pump and controllers, leak checking, system interlock setting). Documented procedures and performed regular MBE system maintenance including growth chamber purging, opening, and cleaning, material charging, leak checking, system baking and cells outgasing.
- Developed growth recipes and the calibration procedure for the MBE growth using techniques including PL, X-ray, and Hall measurements.
- Developed NSL technique to fabricate GaAs nanostructures and novel InGaAs nano-pillars when

combined with O<sub>2</sub> Plasma RIE and Br-IBAE. Developed GaAs mass transport technique to fabricate uniform and optically active InGaAs/GaAs QD structures. Performed structure characterization with SEM and optical characterization with PL.

- Set up photoluminescence measurement system; documented operating procedure; performed PL measurements on various photonics structures and devices.
- Performed wafer and device measurements to characterize surface morphologies such as SEM, TEM and AFM; interface properties, optical and electronic properties of devices including absorption and transmission measurements. Analyzed random fractal behavior of InAs QD using AFM.
- Maintained various vacuum systems used in UML photonics center, such as Varian diffusion pump for E-Beam evaporation system, ion-pump and cryo-pump for MBE systems.
- Performed training to graduate and undergraduate students on PL measurements and other instruments. Actively discussed with other students for different projects.

**2. Teaching Assistant, University of Massachusetts at Lowell** **2003 - 2005**  
• Taught Physics I Lab courses and Physics II Lab courses

**3. Sales Engineer, NTK (Currently Infinova) Corp. Shanghai Site** **2001 - 2002**  
• Performed market analysis on new products (fiber-optic transmitters and receivers).  
• Assisted in developing price strategy for new products.  
• Sold approximately \$200K products on the first year, ranked number 1 out of 5.  
• Supported customers in devices/system installation.

**4. Engineer, Shanghai Yongxin Color Picture Tube (CPT) Co., Ltd.** **1999 - 2000**  
• On-site technical support of customers on TV assembling; played a key role in increasing customer retention as well as satisfaction rates, which saved the company approximately \$20K annually.  
• Communicated with customers and provided feedbacks to the engineering and manufacturing departments for product improvements.

## **EDUCATION**

### **Univ. Of Massachusetts Lowell**

Ph.D. in Physics and Applied Physics August, 2009

**Thesis:** Fabrication of Uniform III-V Quantum Dot Arrays with High Throughput Nanosphere Lithography for Device Applications

Optically active, highly uniform InGaAs quantum dots (QDs) were successfully fabricated using a novel technique that combines NSL, O<sub>2</sub> plasma nanosphere resizing and Br-IBAE dry etch. The narrower PL peak indicates the higher QDs uniformity when compared to self assembled QDs (SAQDs) which show strong size fluctuations. Although this improvement is offset by the degraded optical properties attributed to the crystal damage introduced by the fabrication process, we find mass transporting on selectively etched InGaAs QDs at 600°C can significantly improve the optical properties, showing an increase of PL emission intensity by a magnitude of ten to hundred. This offers an inexpensive viable technique to fabricate 3-D nanophotonic and nanoelectronic devices based on the III-V material systems. Thus, this technique can be easily implanted in many laboratories all over the world.

Master of Science in Physics and Applied Physics 2005

### **Fudan Univ., Shanghai, China**

Bachelor of Science in Materials Science 1999

## PUBLICATIONS

1. **Xifeng Qian**, Shivashanga Vangala Daniel Wasserman, William D. Goodhue, “High-Optical-Quality Nanosphere Lithographically Formed InGaAs Quantum Dots Using MBE-Assisted GaAs Mass Transport and Overgrowth”, (submit to The Journal of Vacuum Science and Technology B)
2. Andriy A. Danylov, Thomas M. Goyette, Jerry Waldman, Michael J. Coulombe, Andrew J. Gatesman, Robert H. Giles, William D. Goodhue, **Xifeng Qian**, and William E. Nixon, “Frequency stabilization of a single mode terahertz quantum cascade laser to the kilohertz level”, Optics Express Vol. 17, Iss. 9, 7525-7532 (2009)
3. **X. Qian**, J. Li, D. Wasserman, and W.D. Goodhue, “Uniform InGaAs Quantum Dot Arrays Fabricated Using Nanosphere Lithography”, Applied Physics Letters 93, 231907 (2008). Selected for the Dec. 22, 2008 issue of Virtual Journal of Nanoscale Science & Technology. The Virtual Journal, which is published by the American Institute of Physics and the American Physical Society in cooperation with numerous other societies and publishers, is an edited compilation of links to articles from participating publishers, covering a focused area of frontier research
4. **Xifeng Qian**, Jin Li, and William D. Goodhue, “Nanohole and Nanopillar Arrays on GaAs and GaSb Using Nanosphere Lithography and Bromine Ion Beam Assisted Etching”, Materials Research Society Symposium Proceedings 1059-KK11-10 (2008)
5. Li, Jin; **Qian, Xifeng**; Liu, Wayne; Vangala, Shivashankar R.; Goodhue, William D.; Danylov, Andriy A.; Waldman, Jerry; Giles, Robert H.; Linden, Kurt J, “2.4-2.5 THz Quantum Cascade Lasers Obtained by Tuning the Thicknesses of a Structure Emitting at 2.9 THz”, The 20th Annual Meeting of the IEEE, Lasers and Electro-Optics Society, 2007. 21-25 Oct. 2007 Page(s):860 – 861
6. Xuejun Lu, Mark J. Meisner, Jarrod Vaillancourt, Jin Li, **Xifeng Qian**, and William D. Goodhue, “Modulation-doped InAs-InGaAs quantum dot longwave infrared photodetector with high quantum efficiency,” IEEE Electronics Letters, Vol. 43, Issue 10, p. 589-590 (2007)
7. Vangala, S. R.; **Qian, X.**; Grzesik, M.; Santeufemio, C.; Goodhue, W. D.; Allen, L. P.; Dallas, G.; Dauplaise, H.; Vaccaro, K.; Wang, S. Q.; Bliss, D. “Molecular beam epitaxy and morphological studies of homoepitaxial layers on chemical mechanical polished InSb(100) and InSb(111)B substrates”. Journal of Vacuum Science & Technology, B: Microelectronics and Nanometer Structures--Processing, Measurement, and Phenomena (2006), 24(3), 1634-1638.
8. Vangala, S. R.; Krejca, B.; Krishnaswami, K.; Dauplaise, H.; **Qian, X.**; Zhu, B.; Ospina, M.; Sung, C.; Vaccaro, K.; Bliss, D.; Goodhue, W. D. “Preparation and patterning of GaSb surfaces with Br-IBAE for antimonide based molecular beam epitaxy”. Materials Research Society Symposium Proceedings (2004), 792(Radiation Effects and Ion-Beam Processing of Materials), 569-574.

## REFERENCES

Available upon request