Water Equipment & Policy
I/UCRC Research Center

Miniturized differential microcalorimeters to detect bio/chemicals in water in real-time

Dr. Chung-Hoon Lee
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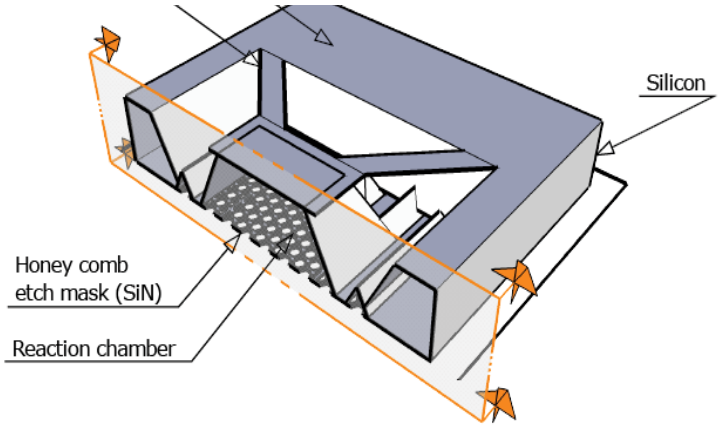
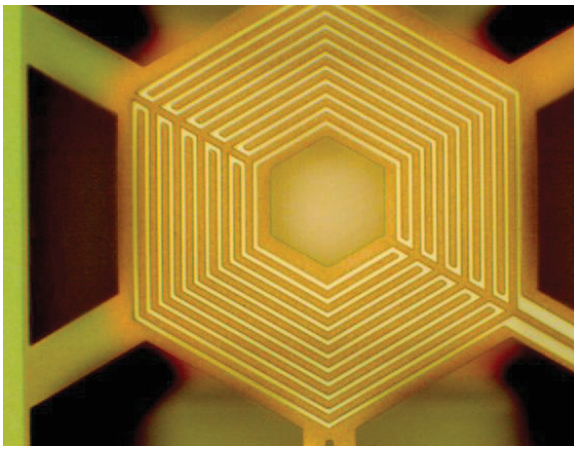
Dr. Chung-Hoon Lee is an Assistant Professor of Electrical and Computer Engineering at Marquette University. He is also the Director of Marquette's Nanoscale Devices Laboratory. His laboratory is a facility for research on micro/nano scale devices, including:

- Micro-Differential Scanning Calorimeter (DSC): design, development, and characterization of micromachined differential scanning calorimeter for bio/chemical molecules in applications of temperature reference, rapid DNA detection, Drug discovery, and bio/chemical sensors.
- SiNWs: wafer-scale integration of silicon and silicon germanium Nanowires, electrical and thermal analysis.
- Tip-based Nanofab: developing micromachined bow-tie antenna for local optical field enhancements to controlled nanowire array growth.
- Molecular electronics: Design and fabrication of multi-nanogap electrodes as a platform for single molecule electronics. Electrical and thermal measurement of single molecule and analysis.
- AFM/SPM probes: Multi-functional AFM/SPM probe development and characterization.





Thermal properties (melting temperature, heat capacity) of bio/chemical molecules are unique. Dr. Lee's miniaturized micro-calorimeter array measures the thermal properties of bio/chemical molecules in water with ultra high sensitivity in real-time. A differential scanning calorimeter consists of two identical reaction chambers, temperature sensors, and heaters. The temperature between a reference and sample is continuously monitored while heat is applied to the two chambers. By recording the heat required to minimize the temperature difference between the reference and sample, thermodynamic properties of the sample can be extracted.

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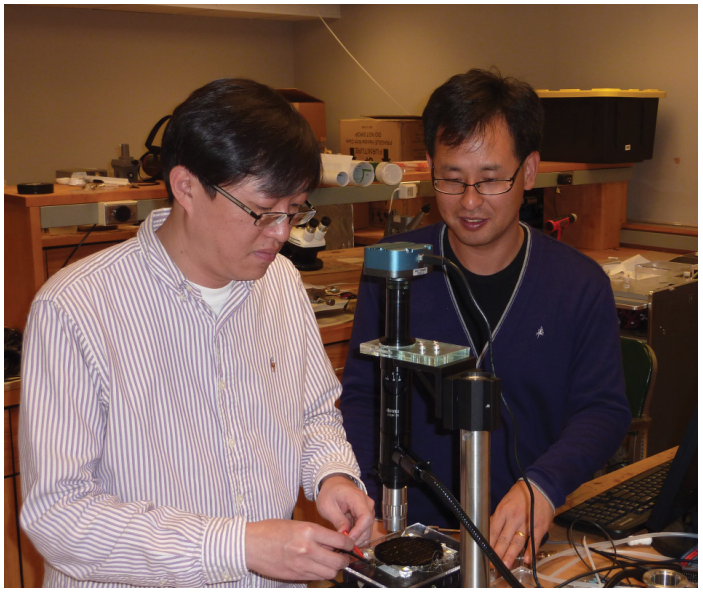
Dr. Lee's Nanoscale Devices Research Laboratory

Dr. Lee's Nanoscale devices laboratory is a facility for research on micro/nano scale devices, including Nano differential scanning calorimeter, Silicon Nanowires, tip based nanofabrication, molecular electronics, and AFM/SPM probe development and characterization. Lab equipment includes: high temperature oxidation furnace for thermal SiO2 growth, MILA-5000 Mini Lamp Annealer, Reactive Ion Etcher (RIE) for thin film etching, mask aligner, HMDS vapor coating, photoresist spinner, metal evaporator and sputtering system, silicon anisotropic wet etching system, anodic bonding system, Scanning Electron Microscope (SEM), Chemical Vapor Deposition (CVD) system for nanowire growth, and measurement system with Labview control.



Representative journal publications:

1. C.-H Lee, C. S. Ritz, M. Huang, M. W. Ziwisky, R. J. Blise, and M. G. Lagally, "Wafer-scale integrated freestanding single-crystal silicon nanowires: conductivity and surface treatment," Nano Letters, submitted.
2. C.-H Lee, C. S. Ritz, and M. G. Lagally, "Fabrication of and Electrical Measurements on Integrated Single Crystal Silicon Nanowires," 2008 MRS Fall Meeting Symposium, Boston, MA.
3. C.-H Lee, G. Walker, A. ONeill, and D. K. Manikkam, "Micro-Calorimeter with Enclosed Parylene Chambers for Bio/Chemical Applications," Proceedings of the MicroTAS 2008 Conference, San Diego, CA, pp. 1429–1431, 2008.
4. C.-H. Lee, C. Ritz, and M. Lagally, "3-Dimensional Silicon-Germanium Quantum Dots on Freestanding Si Nanoribbon", the Nanoelectronics Devices for Defense & Security conference 2007.
5. P. G. Evans, P. Rugheimer, M. Lagally, C.-H. Lee, A. Lal, Y. Xiao, B. Lai, and Z. Cai, "Microfabricated strained substrates for Ge epitaxial growth," J. Appl. Phys. 97, 103501, 2005.

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