CIRMM/LIMMS

FUJITA LAB.

[Nano Mechatronics for Science and Industrial Technology]

Centre for International Research on MicroNano Mechatronics

http://www.fujita3.iis.u-tokyo.ac.jp/

Nanotechnology, Biotechnology

Department of Electrical Engineering and Information Systems

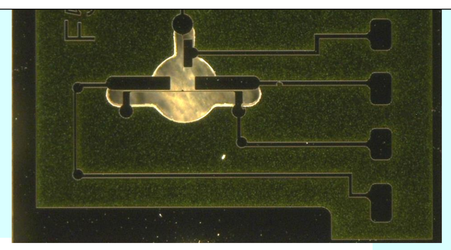
From the beginning of MEMS (Micro Electro Mechanical Systems), our group has investigated the fabrication technology and applications of MEMS in the forefront of the field. Currently we focus on MEMS application to three major research fields, “nanotechnology”, “biotechnology” and “Energy harvesting”. In nanotechnology, the combination between MEMS and TEM (Transmission Electron Microscope) enabled us to study nano physics under in-situ observation. In biotechnology, the combination between molecule and MEMS opened a new scientific field, which cannot be realized by bulk experiment. Also MEMS technology is applied for a novel energy harvester using ionic liquid.

Physics in Nanoworld

We combined “MEMS opposing tips” and “TEM” with atomic resolution and real time imaging”. With this setup, called MEMS-in-TEM, the formation and deformation of nano-scaled junction were in-situ observed, while unique properties of nano structures were measured.

MEMS-in-TEM

MEMS



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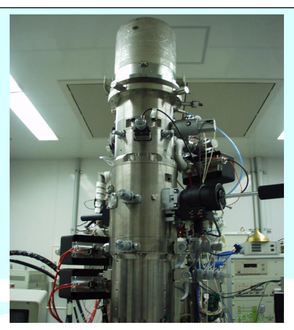
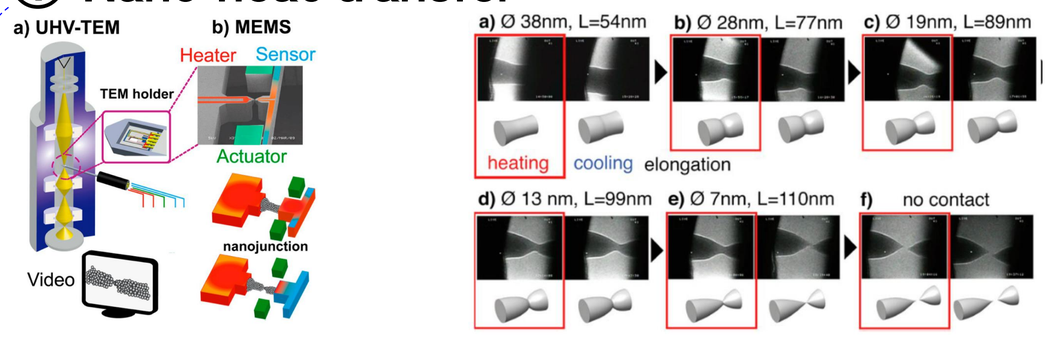
Transmission Electron Microscope

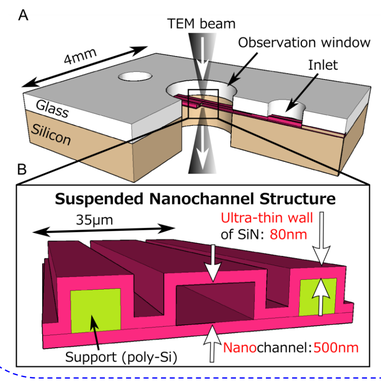


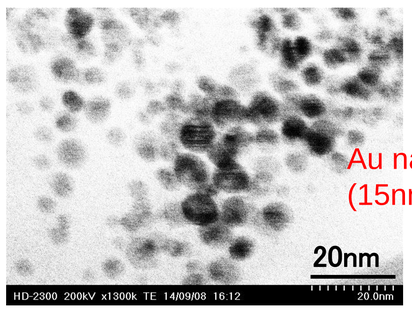
① Nano heat transfer



A ballistic heat transfer event was measured

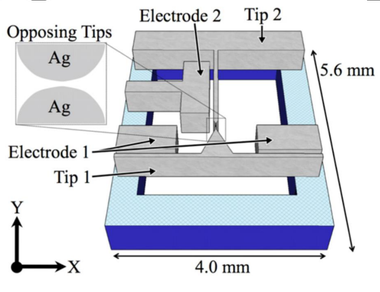
② Liquid cell

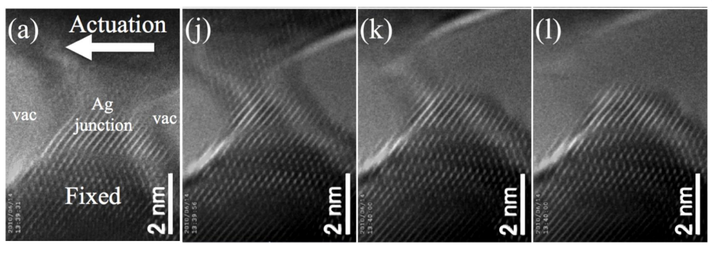




Au nano-particle in water

③ Nano tribology



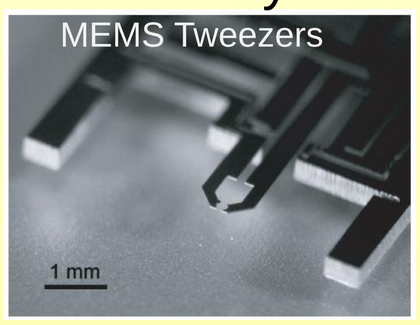


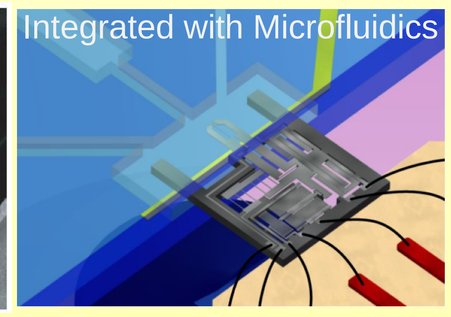
Atomic stick-slip phenomena were observed

MEMS for Biological applications

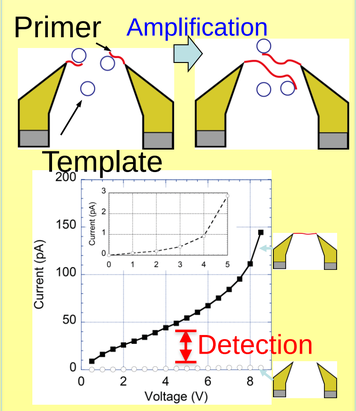
Transportation and reaction measurement of ultra small bio materials, especially single molecular/ cellular level, were achieved using MEMS devices.

Handling and Characterization of Biosamples by MEMS Tweezers



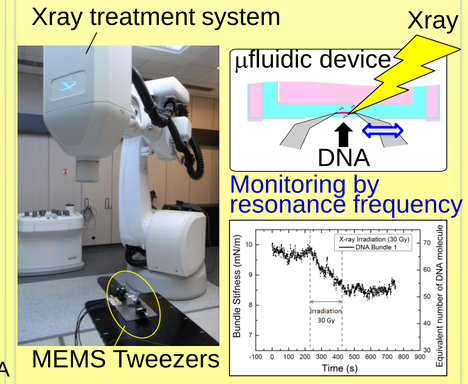


DNA amplification on tip and detection



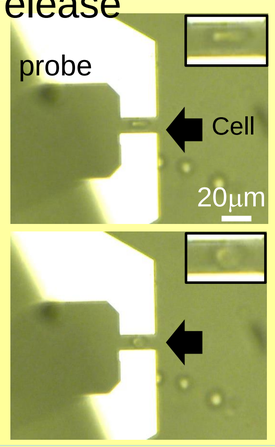
Electrical detection of amplified DNA

Monitoring of DNA degradation by Xray irradiation



MEMS Tweezers

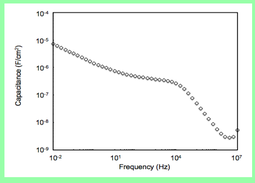
Cell trapping, compression and release

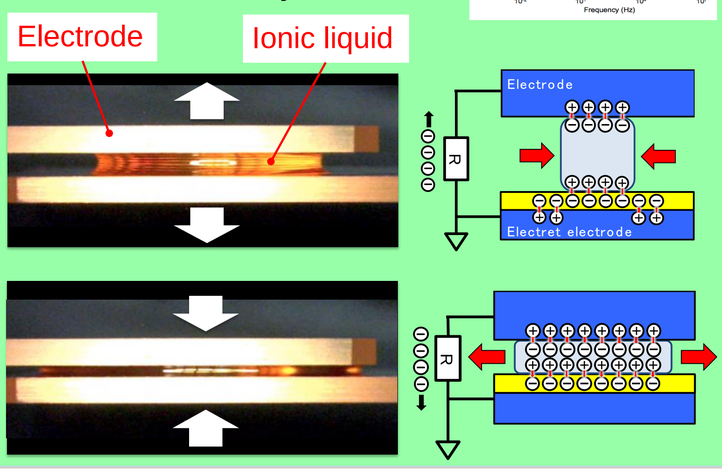


MEMS for Energy harvesting

We are applying ionic liquids to energy harvesters for micro-sized, mechanically robust devices capable of producing large output current from low frequency vibration in the environment.

Our novel method for energy harvesting is based on the large capacitance due to the electrical double layer.





Vibration at low frequency in environment is extracted and converted to current.