Low-cost MEMS fabrication technology using a replica molding technique

Possible development of new applications of resin MEMS devices

The developed technology makes it possible to fabricate MEMS devices by using the printing technology that enables the fabrication of large-area devices without a vacuum process and the injection-molding technology that requires small capital investment and enables low production costs. MEMS devices currently produced by using semiconductor manufacturing processes can now be fabricated inexpensively and with a small capital investment. This allows the applications of MEMS devices in fields where MEMS cannot currently be used owing to high production costs and low production volumes. For example, new applications in the lighting industry can be developed by combining active variable light distribution by a MEMS mirror and LED lighting.

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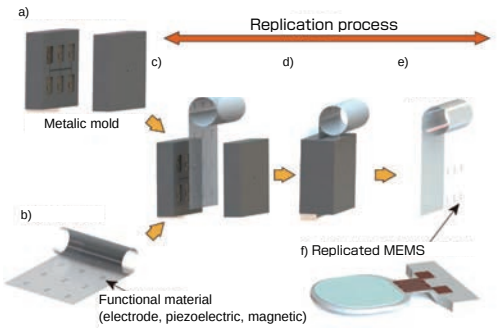
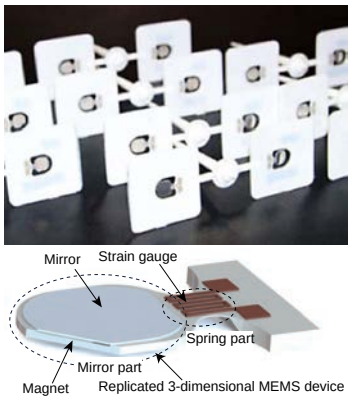


MEMS fabrication processes using printing and injection-molding



Examples of MEMS devices fabricated by using the developed technology

Determination of the absolute intensity of X-ray free electron lasers (XFELs)

Pulse energies validated through calibration of on-line monitors

The pulse energies of a free electron laser have been accurately measured in the hard X-ray spectral range using a cryogenic radiometer. The experiment was performed at the hard X-ray laser facility SACLA (SPring-8 Angstrom Compact free-electron LAser). The cryogenic radiometer is a thermal detector operated close to the liquid helium temperature of 4.2 K. They are electrically calibrated, based on the equivalence of electrical and radiant heating of a cavity absorber of almost 100 % photoabsorptance. Pulse energies up to 100 μJ were measured with the uncertainties from 1.1 % to 3.1 %, mainly due to the intensity fluctuations of SACLA. Using the absolute pulse energies, a SACLA online monitor was calibrated in the spectral range. Reliable pulse energy data are provided now for all current and future experiments at SACLA. We have a plan to develop a new radiometer operated at room temperature.

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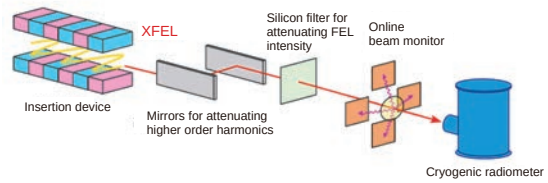

Schematic diagram of the experimental set-up at the beamline

Wavelength of the XFEL (nm)	Average pulse energy (μJ)
0.28	32.26 ± 0.35
0.21	104.2 ± 1.3
0.13	95.3 ± 2.3
0.091	42.2 ± 1.1
0.074	0.96 ± 0.03

Average pulse energy measured with the cryogenic radiometer