Chapter 5 Conclusion and future work

In the thesis, the comb actuators of the reflection type and absorption type spot scan systems were designed and fabricated. A prototype of the optical spot scanning system fabricated using MUMPs was demonstrated. Besides, a new integration process was developed to fabricate the absorption type device and the fabricated responsivity of the photo detector was characterized.

Howerever, the interference of the optical path of the reflection type scan system made the measured spot size much larger than the predicted calculation. To reduce the spot size, the plano-concave lens should be replaced with a moderated beam expander and well aligned optical components in the optical path. Moreover, the propagation from the knife-edge plate to the detector can be eliminated by integrating the detector with the knife-edge plate, such as the design in the <111> fabrication device.

During the fabrication of the <111> silicon device, a PECVD sidewall passivation film with good step coverage is deposited at higher RF power and lower deposition pressure. To solve the corner attack during RIE, a dry releasing process is used.

From the viewpoint of actuator design, the driving voltage is too large in both devices. In order to measure the spot with nanometer scale, the resonance frequencies of vertical and torsional modes should be separated from the lateral mode as much as possible. The driving voltage of actuator can be reduced by decreasing the finger gap and the width of spring. To separate the three major resonance modes and reduce the coupling between lateral and vertical displacement, increasing the thickness in <111> silicon device is a plausible solution [13]. However, the thicker the structure in the <111> fabrication is, the larger the driving voltage becomes due to the limitation of

sidewall implementation depth. To solve the sidewall implementation at low temperature, a high-aspect ratio implantation technique, Plasma Immersion Ion Implementation (P.I.I.I.) [23], can be used. The integration can be improved by trench refill technique [27]. Finally, the responsivity of the detector in the absorption type can be increased by the N^+ ring in the N-well design [28].