Design and fabrication of micro optical system for multi-optical probe confocal microscopy for large areal measurement

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Very recently, use of a confocal microscopy for inspection of large areal objects such as display panel and printed circuit board is considered as one of the most promising technologies. The critical dimension of the pattern is too small to test using vision optics based conventional inspection systems.[1]
In this research, to investigate a feasibility of confocal microscopy for large areal inspection, a multi-optical probe confocal microscopy which has 1mm x 1mm inspection area using 100μm treble length nano-stage was designed and constructed.
A multi optical probe confocal microscopy has been developed using micro objective lens array. A microlens array for objective lens array with focal length of 100μm, diameter of 80μm and pitch of 90μm was designed with the array dimension of 10 x 10. A filtering layer under the microlens array was fabricated for minimizing noise for high resolution imaging. The microlens array with fidelity was fabricated by UV imprinting process as shown in the figure 1. A UV transparent mold for imprinting process was manufactured by replicating reflow lens master using UV imprinting process.[2,3] The geometrical deviation between designed value and final imprinted objective lens profile is under 0.5%. To evaluate spot size of the objective lens at the focal plane, a beam profiler was used. As shown in figure 2, spots were generated uniformly with the size of the 1.227μm. To avoid a loss of information during the scanning process, it is necessary to stick to the Nyquist theorem.[4] In this study, 0.5 μm of scanning interval was used for imaging to avoid information loss. Finally, to test a feasibility of the developed optical system, various micro structures were measured as shown in the figure 3.
It is considered that the multi optical probe confocal microscopy can be used for on-line inspection system for large areal objects because the optical system is very simple and the micro objective lens array can be manufactured at low cost. Measurement of centimeter-order scanning area with resolution of 1μm is a subject of ongoing research.

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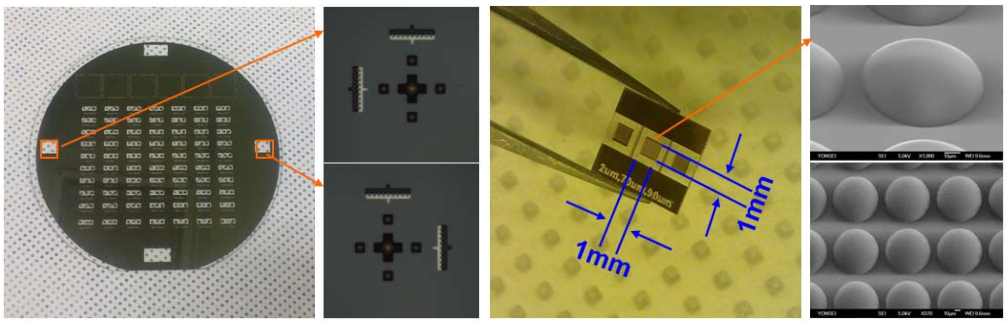
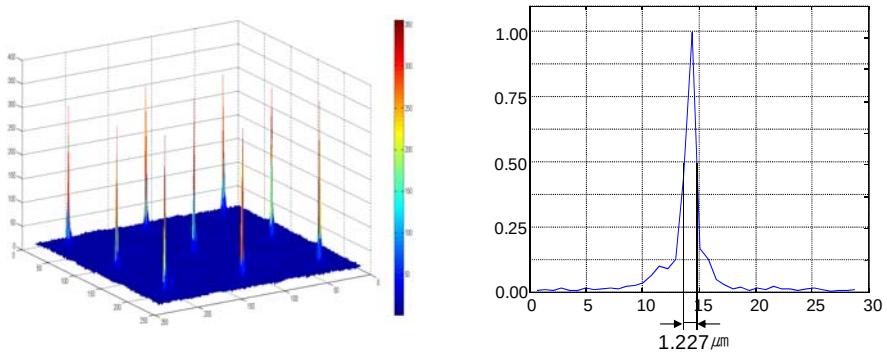


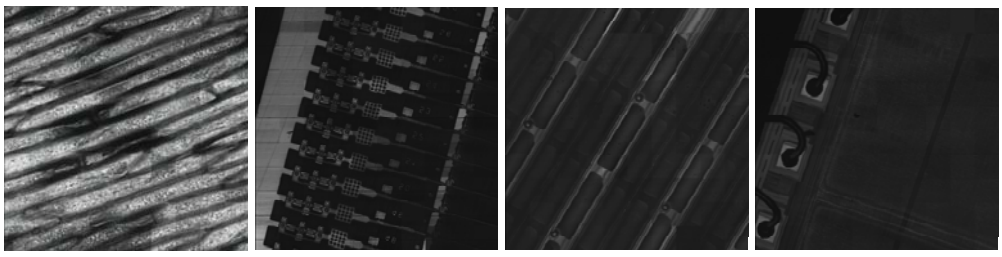
(a) (b)

Figure 1: Photograph and SEM measurement results of the (a) micro objective lens array with filter structure in a wafer scale and (b) diced micro objective lens array



(a) (b)

Figure 2: Measurement results of beam profiles at the focal plane of the objective lens (a) 3x3array observation (b) value of FWHM of the objective lens is about 1.227 μm



(a) (b) (c) (d)

Figure 3: Various imaging examples using multi optical probe confocal microscopy (a) plant cell (b) LCD circuit (c) ITO transparent electrode of the display panel (d) wire bonded structure of CMOS image sensor

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