Supplemental Document

Optics Letters

Integration of microlenses on surface-micromachined optical ultrasound transducer array to improve detection sensitivity for parallel data readout: supplement

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Integration of micro lenses on surface-micromachined optical ultrasound transducer (SMOUT) array for enabling parallel data readout: supplemental document

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This document contains additional information to "Integration of micro lenses on surface-micromachined optical ultrasound transducer (SMOUT) array for enabling parallel data readout", including 1) the 2D profile of the PR MLs compared with that of the ideal spherical lens, 2) the optical transmittance spectrum of the SMOUT-ML elements, and 3) 3. The temporal stability testing results the SMOUT-ML elements immersed in water.

1. PR ML profiling

Fig. S1 shows the 2D profile of the PR micro lenses obtained by a mechanical profiler (DektakXT, Brucker), which is compared with that of an ideal spherical lens. The curvature radius of the ideal lens is estimated based on the formula in [1]. The two profiles are highly consistent with each other, though there's small discrepancies probably due to the tilting of the substrate during the thermal reflowing process. Such results demonstrate the spherical profile of the PR lenses and validate the quantitative analysis/design of the PR lenses utilized in this work.

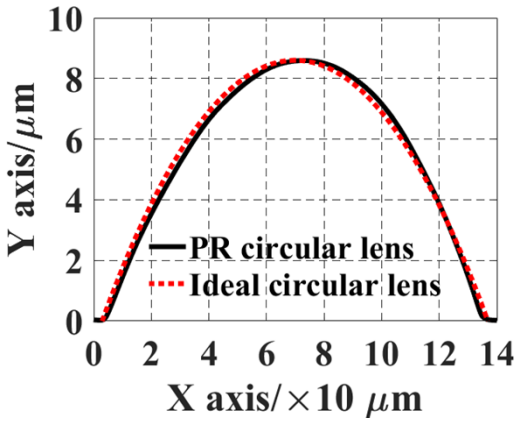

Fig. S1. Comparison between profiles of a PR circular lens and the ideal circular lens

2. Optical spectroscopic characteristics of the SMOUT-ML elements

To reveal the spectroscopic properties of the SMOUT-ML elements, light from a Tungsten lamp (HL-2000-LL, Ocean Insight) is loosely focused and incident onto the array from the ML side. The transmittance spectrum of the array from 500 to 900 nm is obtained by a spectrometer (USB4000, Ocean Insight), as shown in Fig. S2. The array is highly transparent in short wavelength range (500–680 nm). Meanwhile, the device is more reflective (around 80%) in longer wavelengths (760–815 nm) to achieve optical resonance and sensor signal readout.

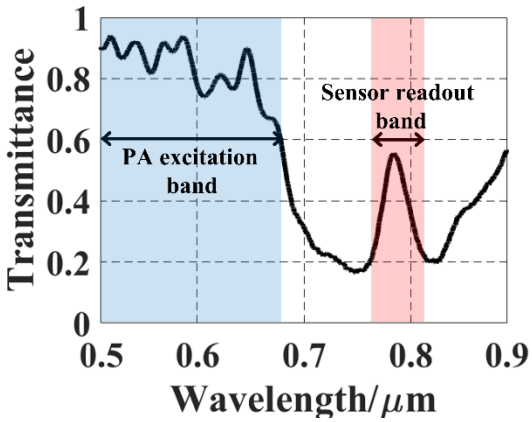

Fig. S2. Transmittance spectrum of the SMOUT-ML array

3. Temporal stability testing results

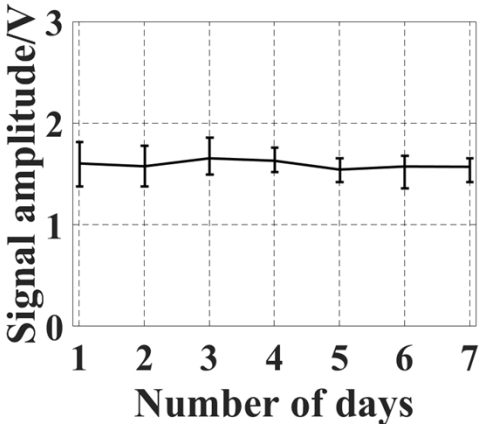

Fig. S3. RMS amplitude of ultrasound signals obtained from three tested locations of the SMOUT-ML array immersed continuously in water 24 hours a day for 7 days. The error bars indicate the STD of the signal amplitude.

References

[1] D. Daly, R. F. Stevens, M. C. Hutley and N. Davies, "The manufacture of microlenses by melting photoresist," Meas. Sci. Technol.**1**, 759-766 (1990).