

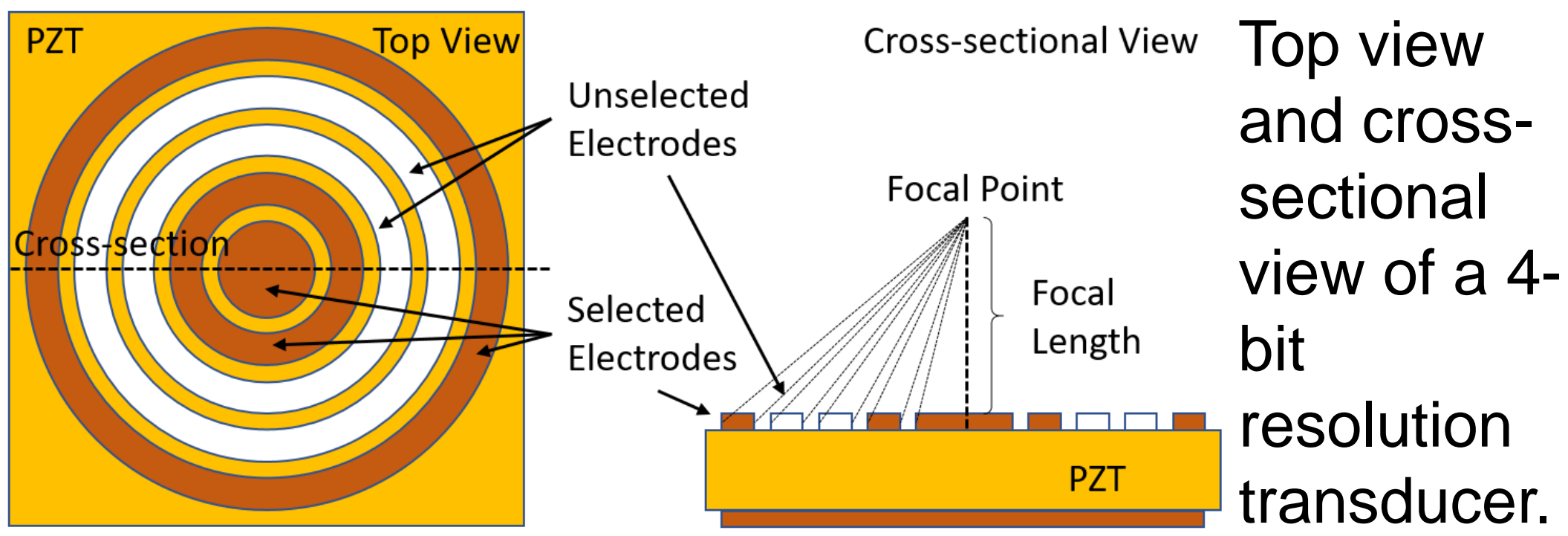
Focused Ultrasound Transducer With Electrically Controllable Focal Length

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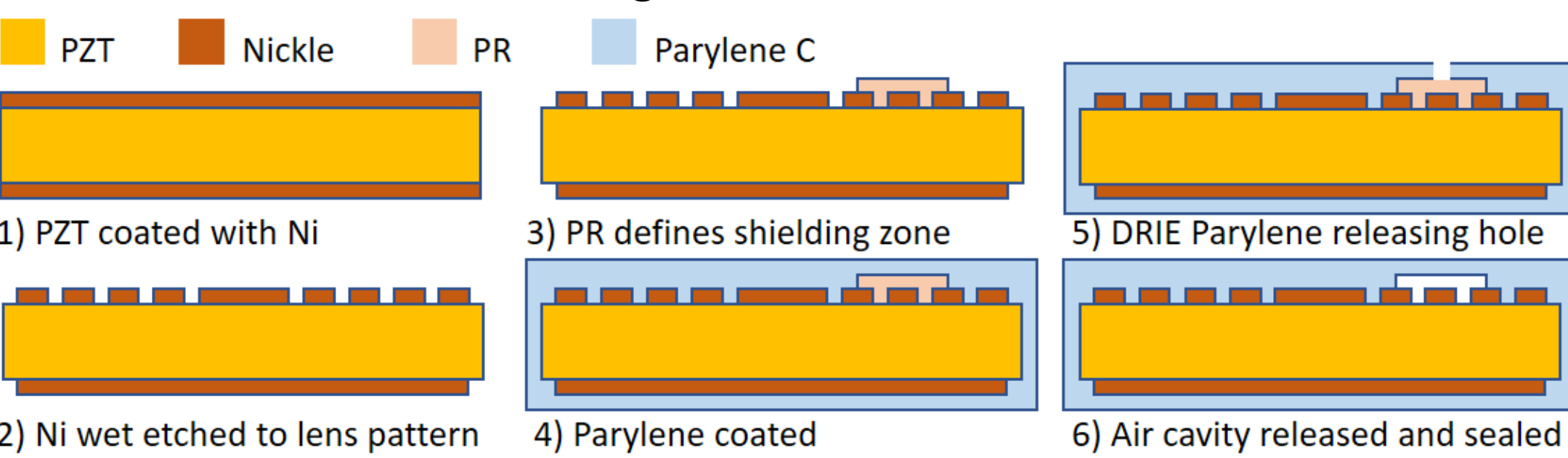
Motivation & Introduction

Focused ultrasound (FUS) has a wide application potential in imaging, tumor treatment, neuron stimulation, etc. However, all the previously designed transducers are of a fixed focal length, with no electrical controllability for the focal length, and are incapable of dynamically changing the focal spot without physically moving the transducer. The new device described here offers tremendous degree of operating freedom by enabling the electrical controllability of the focal length.

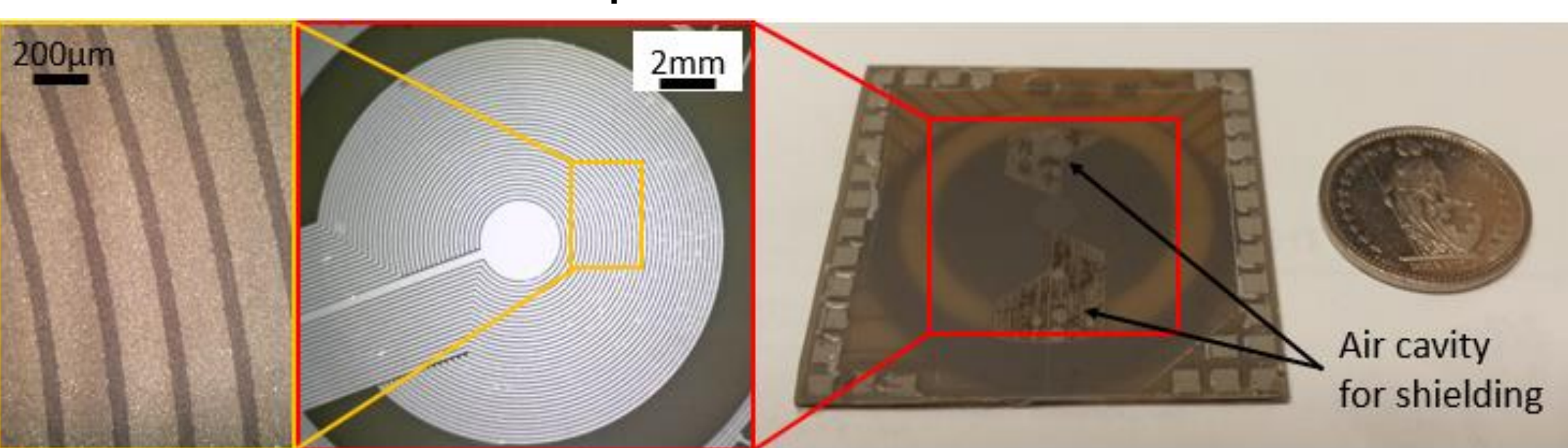
Device & Fabrication



Each of the four equal-width concentric ring electrodes can be selected to generate ultrasound. By varying the selection, the focal length can be varied.



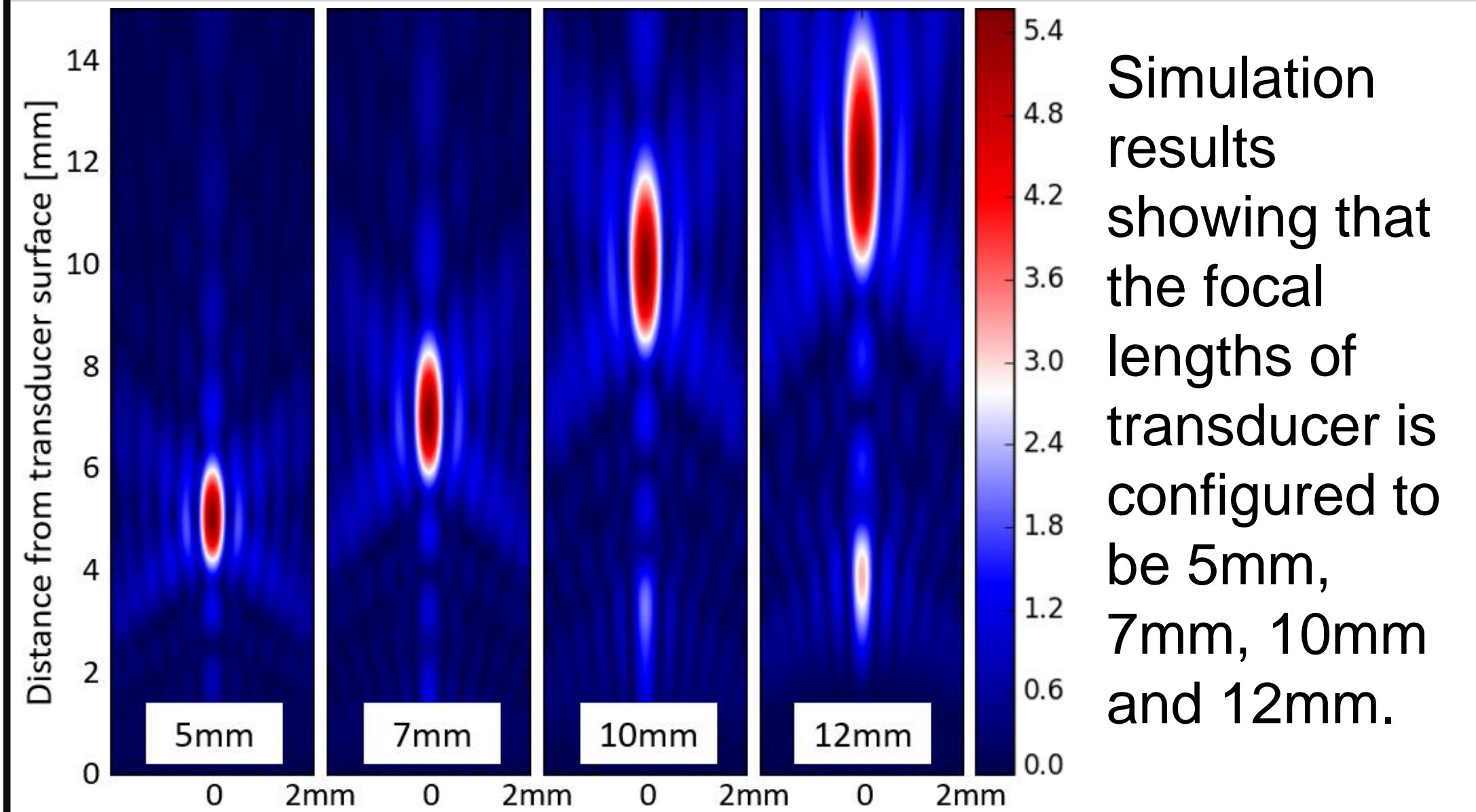
Brief microfabrication process of the transducer.



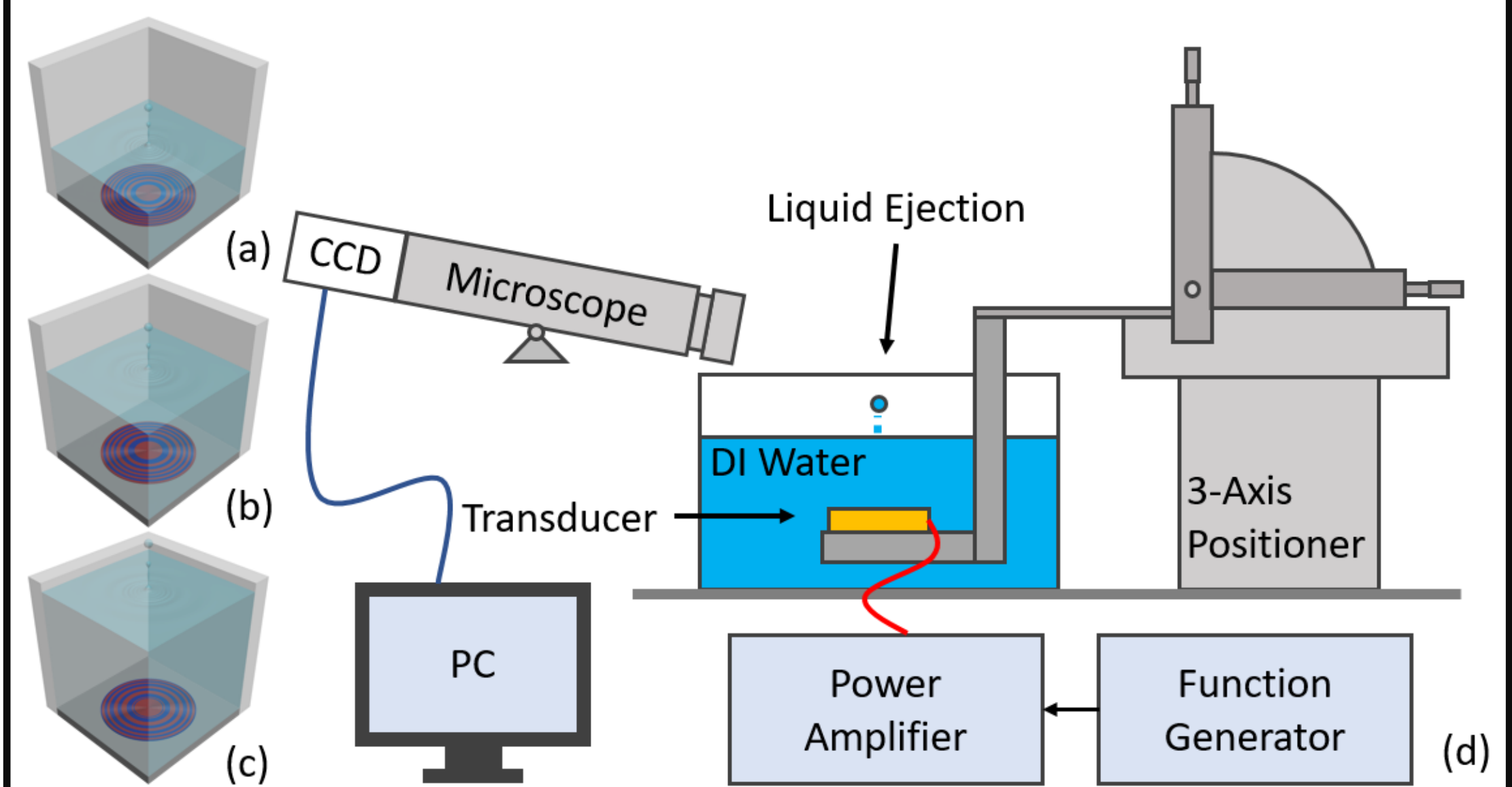
Conclusion

A 32-bit transducer was fabricated, and demonstrated to be capable of electrical tuning of the focal length through liquid droplet ejections. With actuating condition of 2.25MHz, $V_{pp}=430V$, 200 pulse cycles at a pulse repetition frequency of 60Hz, we measured the size of the ejected liquid droplet (corresponding to the focal size) to be dependent on the focal length, as the focal length is electrically varied.

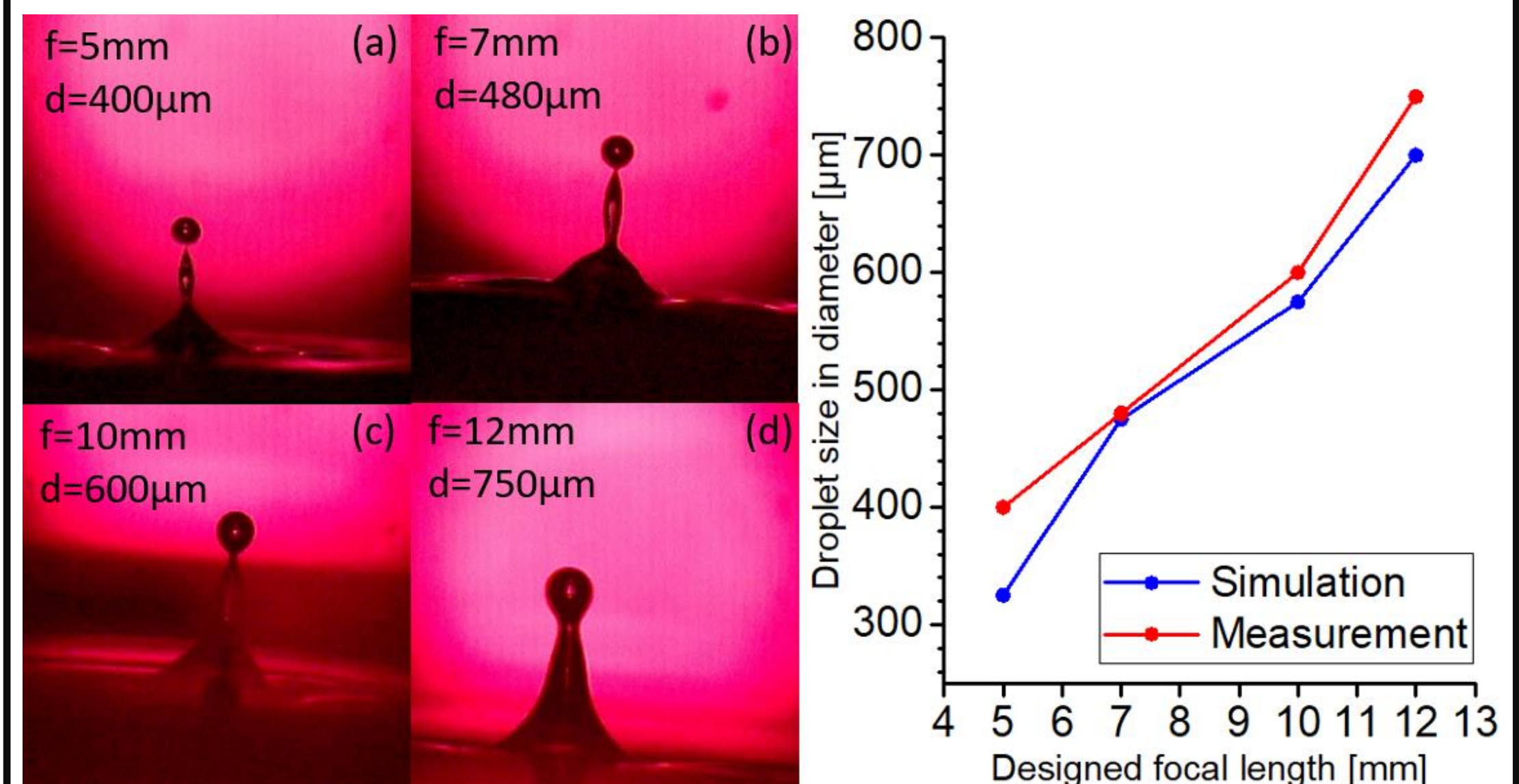
Simulations



Experiments



(a)-(c) Schematics illustrating that water droplets can be ejected at different water height due to the transducer's tunable focal length. (d) Measurement setup to observe droplet ejection with a CCD camera, while the focal length is measured with a micro-positioner.



Cross-sectional-view photos of droplet ejections obtained at the water heights of 5mm (a), 7mm (b), 10mm (c), and 12mm (d).

Ejected droplet size vs designed focal length (both measured and simulated data).