Supporting Information

Wireless Acoustic-Surface Actuators for Miniaturized Endoscopes

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# Equal contribution

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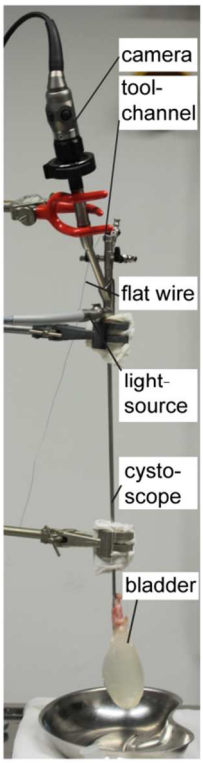
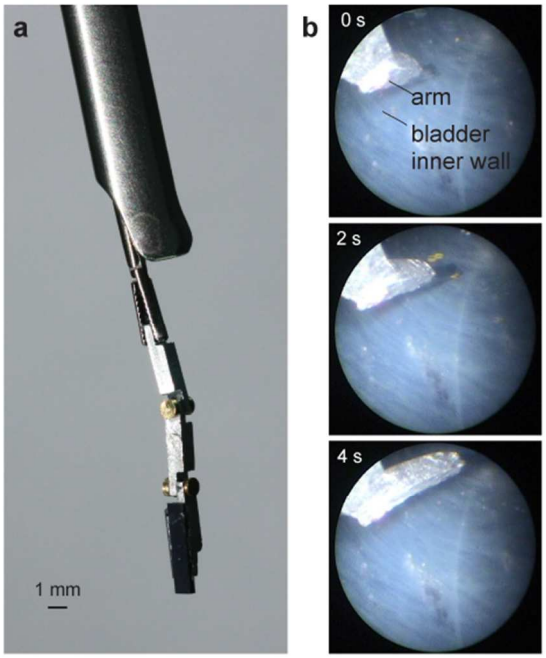
Supporting Video S-1. Wireless actuation of the mechanical arm. The 1st section is first actuated under 115.3 kHz ultrasound excitation, and the 2nd section is actuated with ultrasound at 51.3 kHz. Each frequency is switched on and off two times.

Supporting Video S-2. Wireless actuation of the flexible arm. The ultrasound is switched on and off three times with a driving voltage of 72 V_{rms} at 51.3 kHz.

Supporting Video S-3. Cystoscopy in a rabbit bladder. The left video is recorded by the rigid cystoscope and the right video is recorded by the Naneye camera on the flexible arm. The two videos are synchronized and stacked.



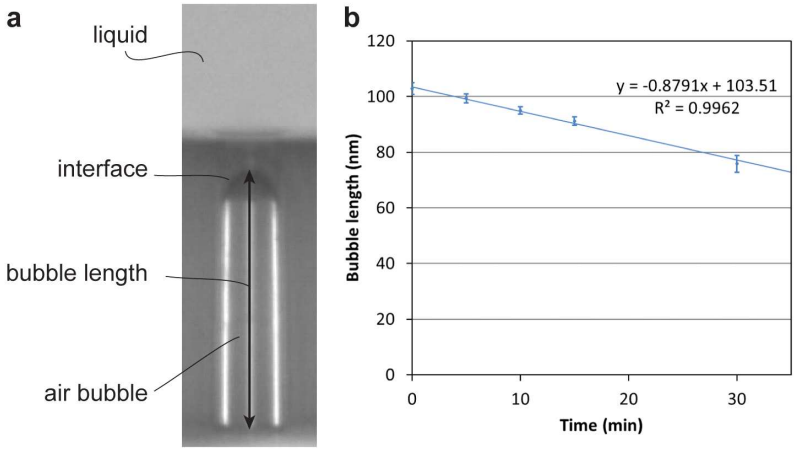
Supporting Figure S-1. Endoscopy set-up for imaging the flexible endoscope prototype in the rabbit bladder.



Supporting Figure S-2. Wireless actuation of the mini-arm inside a rabbit bladder. (a) The micro-arm is held by an endoscopic forceps through the rigid cystoscope to operate in the bladder. (b) Sequential snapshots of a video taken from the cystoscope, confirming the wireless actuation of the arm inside the rabbit bladder via ultrasonic streaming.

Supporting Methods. Measurement of the bubble stability over time

The surface of the micro-cavity was immersed under aqueous SDS solution (2.4 g/L), then the cross section of the bubble array was continuously imaged using light microscopy. An image series was taken at intervals of 5 min for the first 0-15 min and then after 30 min at the end of the experiment. The length of the bubble was defined as the distance between the center point of the curved air-liquid interface and the bottom of the cavity (shown as arrow in Fig. S-3a). Ten bubbles were measured respectively, and the average values of each time point are plotted in Supporting Figure S-3b.



Supporting Figure S-3. (a) Microscopic image of the cross section of a single bubble trapped in a micro-cavity (30 μm in diameter, 120 μm in length). The measured bubble length is labeled with an arrow. (b) Measurement of bubble lengths as a function of time. The error bars represent standard deviations. The air trapped in the micro-cavities

gradually dissolves in water. The length of the bubble changes at a constant rate of ~0.8% of the initial length per minute, and the cystoscopy examination typically lasts 5-15 min, thus the change is so small that no frequency changes are needed.