Supplementary information for

A Two-stage Micro Resistive Pulse Immunosensor for Pathogen Detection

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Measurement Circuit and measurement setup

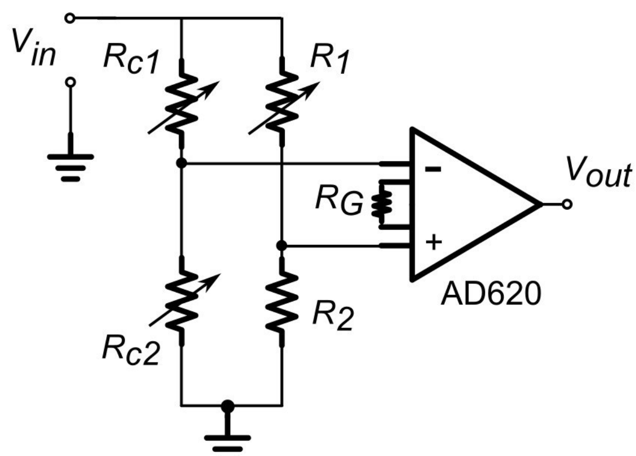

Figure S1. Measurement circuit for the two-stage resistive pulse sensor.

As shown in Figure S1, the two-stage resistive pulse sensor are modeled as R_{C1} and R_{C2} in the circuit. Variable resistor R_1, ranging from 500 kΩ to 1 MΩ, was used to adjust the difference between two input voltages of the differential amplifier to zero. R_2 = 500 kΩ. The gain of the differential amplifier, AD620, was programmed to be 50 using an external gain resistor R_G = 1 kΩ. The input DC signal, V_{in} = 2.4 V, was provided by a function generator (33220A, Agilent). The output signal, V_{out}, was recorded by a data acquisition card (NI USB-6251, National Instruments) at a sampling rate of 500 kHz. Finally, a custom peak detection algorithm (Matlab, MathWorks) was used to count the resistive pulses and back calculate the particle size.

Evaluation of the reproducibility using two additional devices

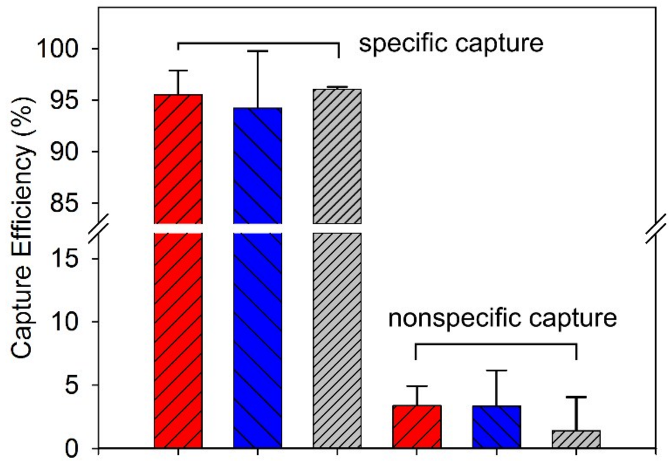

Figure S2. Measured capture efficiency of *S. cerevisiae* and *Chlorella* with anti-*S. cerevisiae* Ab-functionalized MPs (Ab1-MPs). Red, blue and grey columns represent the measurement results from the device presented in the manuscript (Fig. 4) and the additional devices.

To confirm the reproducibility, we used two additional devices with the same design to confirm the reproducibility. We used anti-*S. cerevisiae* Ab-functionalized MPs (Ab1-MPs) to modify the capture chamber and evaluate the specific capture efficiency of *S. cerevisiae*, and nonspecific capture efficiency of *Chlorella*, as shown in Fig. 1. The specific capture efficiency of *S. cerevisiae* was 94.2% and 96.1%, and nonspecific capture efficiency of *Chlorella* was 3.4% and 1.4%, which were very close to those of the device presented in the manuscript.

Calibration of the sizing performance of the two-stage resistive pulse sensor

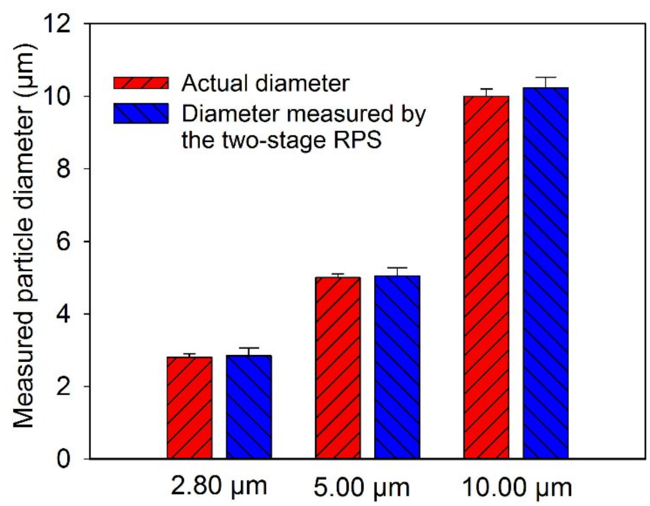

Figure S3. Measured diameter distribution of three types of commercially-available microparticles with nominal diameters of 2.80 ± 0.10 μm, 5.00 ±0.10 μm and 10.00 ± 0.20 μm. The measured particle diameter were 2.84 ± 0.22 μm, 5.04 ± 0.23 μm and 10.23 ± 0.29 μm.

Three kinds of standard spherical microparticles were used to calibrate the sizing performances of the resistive pulse sensor. The diameters of MPs are 2.80 µm ± 0.10µm (Dynabeads M-280, Life Technologies, USA), 5.00 µm ± 0.10µm (79633 FLUKA, Sigma Aldrich) and 10.00 µm ± 0.20 µm (72986 FLUKA, Sigma Aldrich). The diameters of these three kinds of microparticles were also confirmed by a light microscope. The equivalent volume diameters, which were back calculated from the resistive pulses using Eq. 1, were 2.84 ± 0.22 µm, 5.04 ± 0.23 µm and 10.23 ± 0.29 µm, as shown in Figure S3, which were in good agreement with the actual diameters.