Highly Sensitive and Quick Detection of Acute Myocardial Infarction Biomarkers Using In_2O_3 Nanoribbon Biosensors Fabricated Using Shadow Masks

Supporting Information

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Uniformity Test

In order to study the uniformity of the devices fabricated using shadow mask method, we statistically analyzed 50 devices randomly selected from a wafer. After extracting the mobilities of the 50 devices, the histogram is plotted in Figure S1.

Figure S1. Histogram of the mobilities of 50 devices

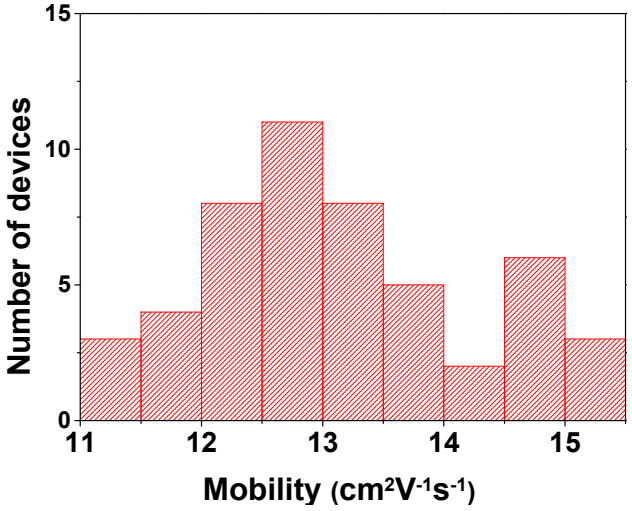

Figure S1. Histogram of the mobilities of 50 devices randomly selected from a wafer, showing the mobility = 13.09 ± 1.39 $cm^2V^{-1}S^{-1}$

PH change

The pH changes between the buffer solutions used for the baseline and the final solutions in the sensing chamber was measured by a commercial Mettler Toledo pH meter.

Figure S2. PH change of Troponin I

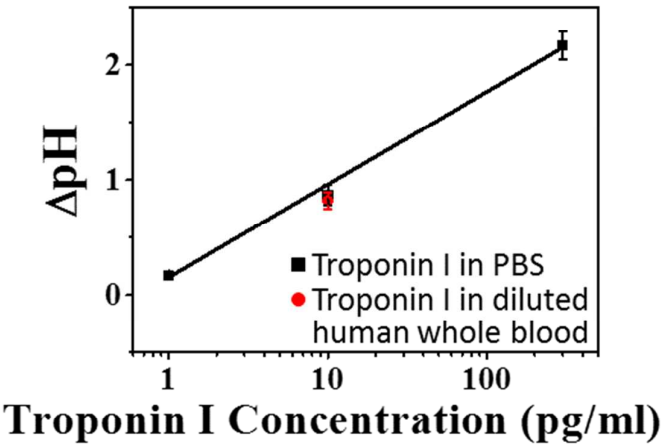

Figure S2. A plot of change in pH in the sensing chamber measured from a commercial pH meter and Troponin I protein concentration in pg/ml.

Figure S3. PH change of CM-MB

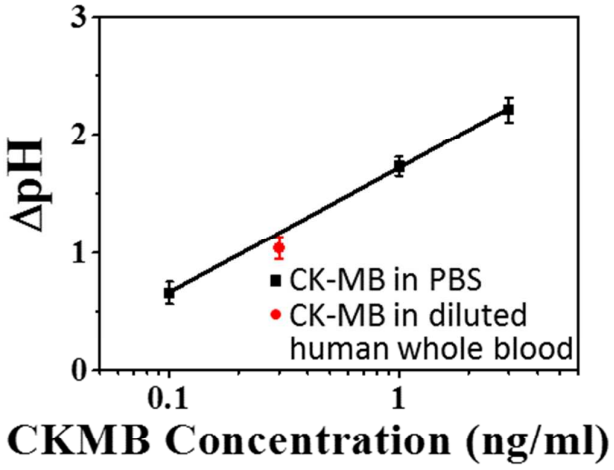

Figure S3. A plot of change in pH in the sensing chamber measured from a commercial pH meter and CK-MB protein concentration in ng/ml.

Figure S4. PH change of BNP

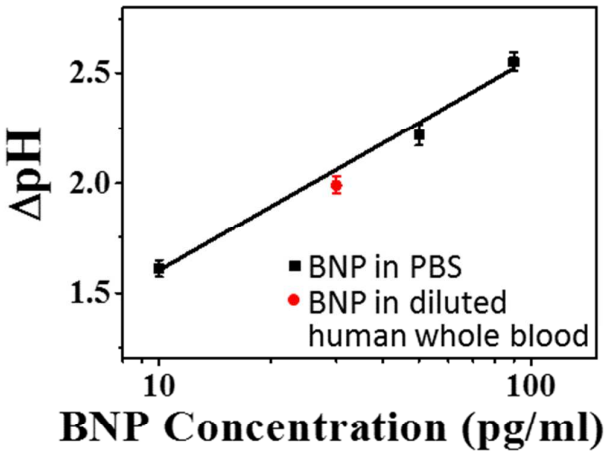

Figure S4. A plot of change in pH in the sensing chamber measured from a commercial pH meter and BNP protein concentration in pg/ml.

Orthogonal Test of Troponin I, CK-MB, and BNP

We also performed the orthogonal tests for the three biomarkers to verify that our technology can distinguish these different biomarkers. The sensor chips were functionalized with cTnI antibodies on the surface as described before, and then each chip was incubated in 100 μL of 1 x PBS buffer spiked with 10 pg/ml of cTnI protein solution, 1 ng/ml CK-MB protein solution and 50 pg/ml BNP protein solution, respectively. After that, we incubated the sensor chip sequentially with biotinylated cTnI antibodies, streptavidin, and biotinylated urease. The results (Figure S5) showed that the sensor chips functionalized with cTnI antibodies only responded to cTnI proteins and there was no current drop for CK-MB and BNP proteins. We also did similar experiments for sensor chips functionalized with CK-MB antibodies and BNP antibodies. The results (Figure S6 and S7) showed that the functionalized sensor chips only responded to the specific proteins. This is consistent with the fact that the antibodies and antigens have specific binding, and our design can effectively minimize the false positive results caused by unspecific binding.

Figure S5. Real-time sensing results from sensor chips functionalized with Troponin I antibody.

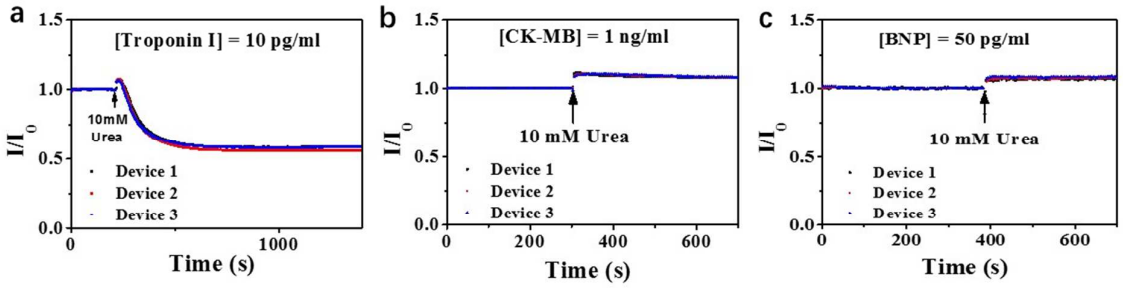

Figure S5. Real-time sensing results from sensor chips functionalized with Troponin I antibody. (a) Incubated in Troponin I antigen solution with concentration of 10 pg/ml. (b) Incubated in CK-MB antigen solution with concentration of 1 ng/ml. (c) Incubated in BNP antigen solution with concentration of 50 pg/ml.

Figure S6. Real-time sensing results from sensor chips functionalized with CK-MB antibody.

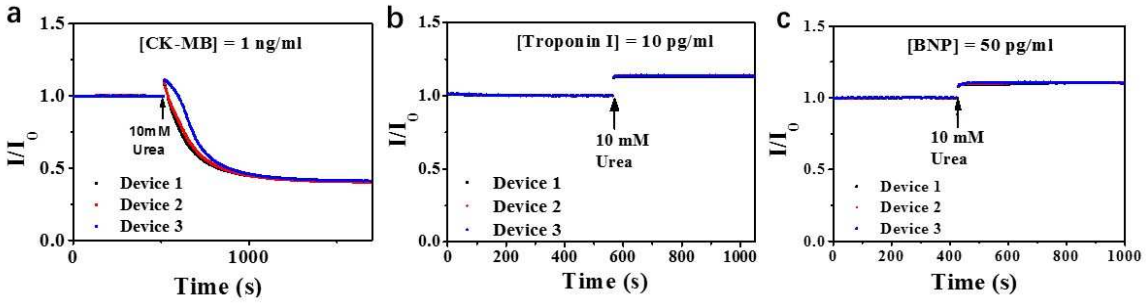

Figure S6. Real-time sensing results from sensor chips functionalized with CK-MB antibody. (a) Incubated in CK-MB antigen solution with concentration of 1 ng/ml. (b) Incubated in Troponin I antigen solution with concentration of 10 pg/ml. (c) Incubated in BNP antigen solution with concentration of 50 pg/ml.

Figure S7. Real-time sensing results from sensor chips functionalized with BNP antibody.

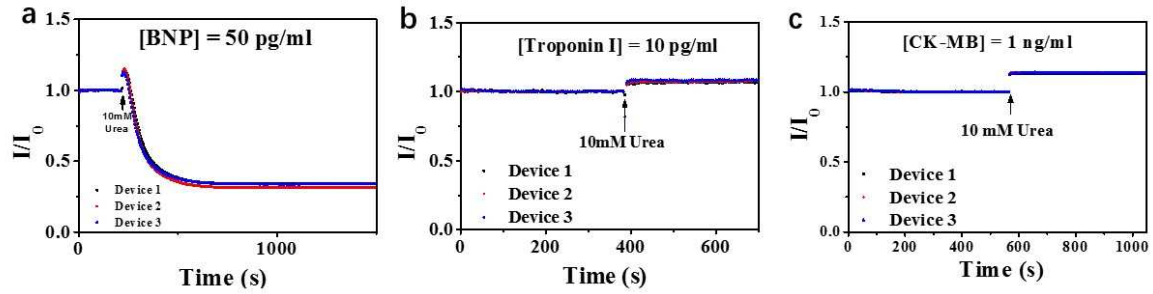

Figure S7. Real-time sensing results from sensor chips functionalized with BNP antibody. (a) Incubated in BNP antigen solution with concentration of 50 pg/ml. (b) Incubated in Troponin I antigen solution with concentration of 10 pg/ml. (c) Incubated in CK-MB antigen solution with concentration of 1 ng/ml.