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Electronic Supplementary Information

Ultra-sensitive in situ detection of silver ions using quartz crystal microbalance

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Theory

QCM measurements are based on the Sauerbrey equation[1]. Sauerbrey equation relates the change in the resonant frequency (Δf) to the change in mass (Δm) due to the adsorption on quartz crystal:

$$\Delta f = -\frac{2{f_0}^2}{A\sqrt{\rho_q \mu_q}}\Delta m$$

QCM can measure the molecular binding without labeling the analyte with fluorophores, as the frequency shift directly corresponds to the mass change of the quartz crystal.

In situ cDNA immobilization

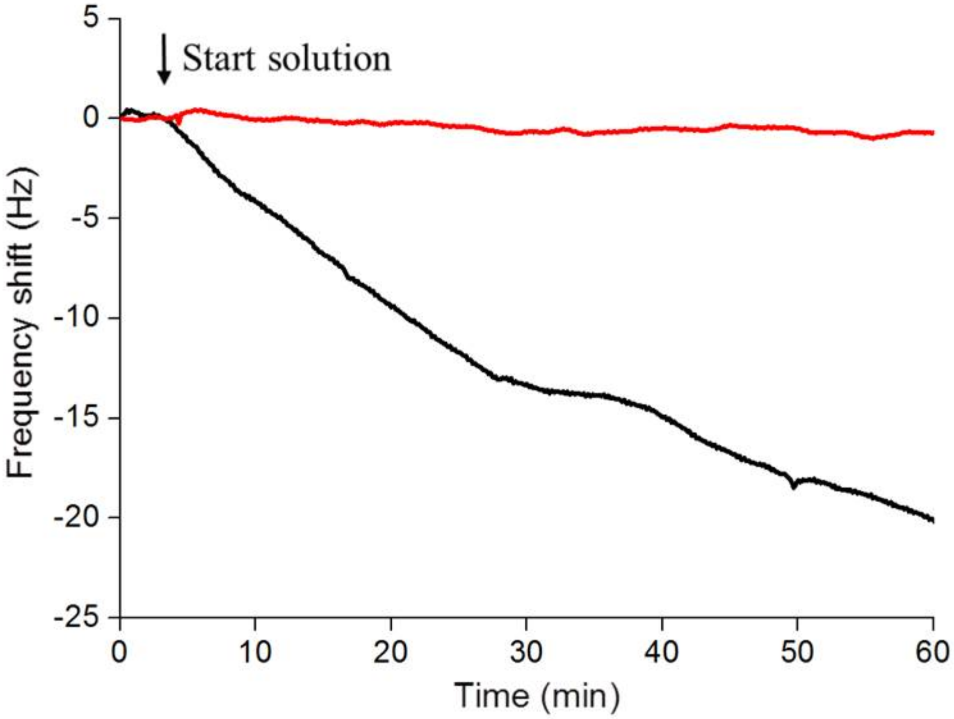

Figure S1. In-situ frequency shift response of bare quartz crystal upon exposure of cDNA solution (black line) and DI water (red line).

Selectivity test in drinking water

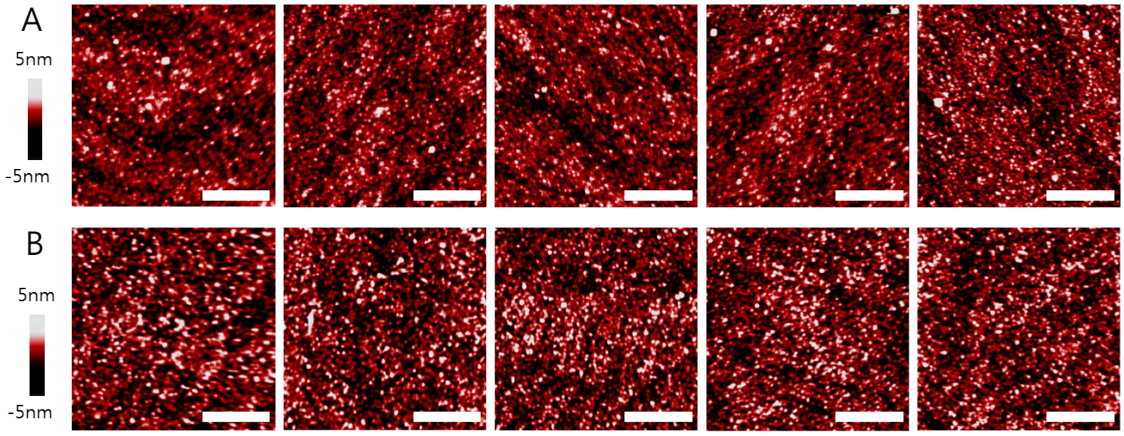

Figure S2. AFM images of bare QCM electrodes (A) and ssDNA immobilized QCM electrodes (B) (bar scale : 1μm).

Reusability

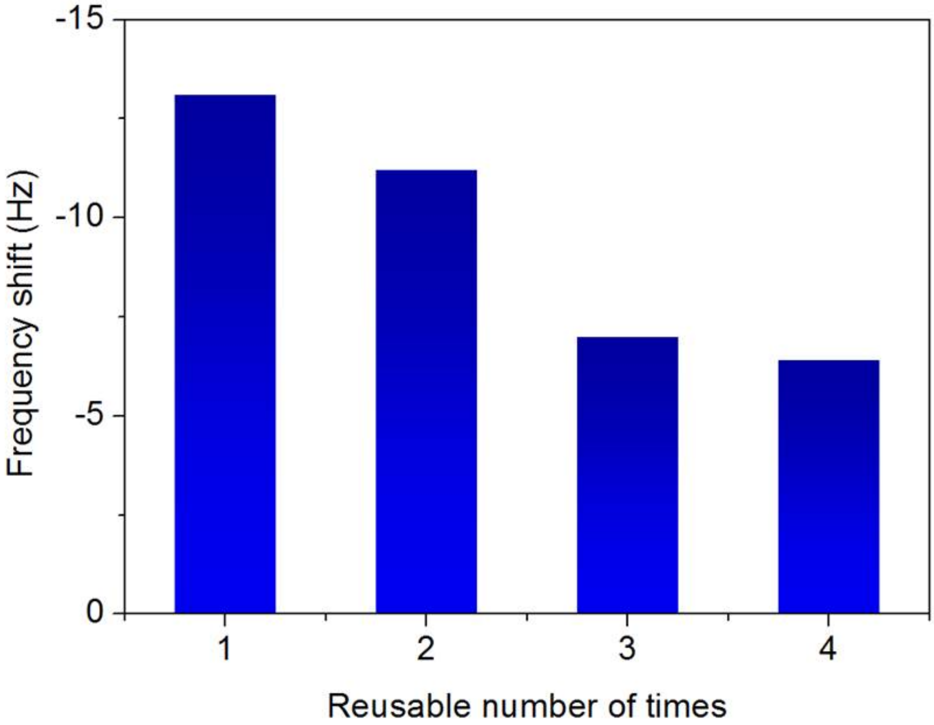

Figure S3. Frequency shift of 1 μM Ag^+ detection with respect to the reusable number of times.

F’ and slope response

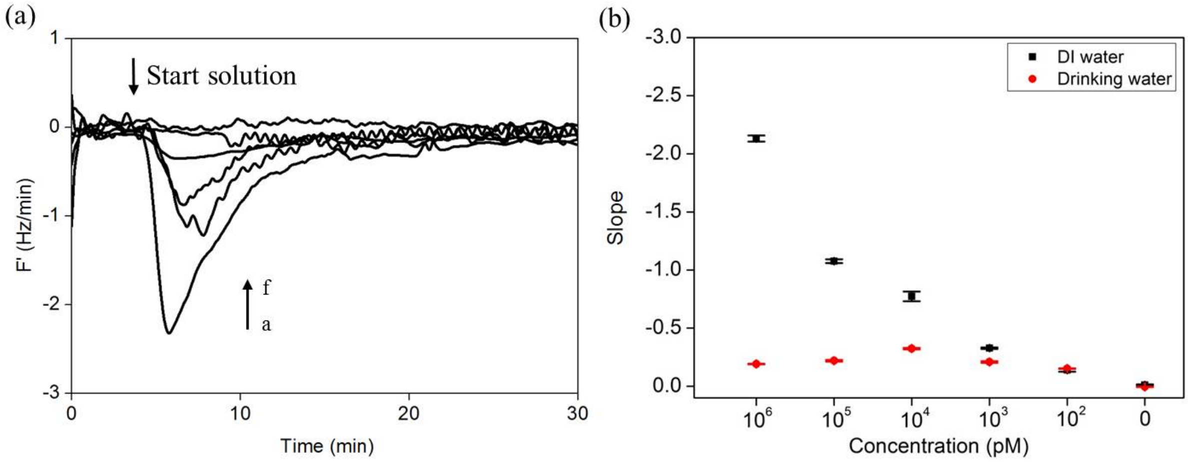

Figure S4. (a) In-situ graphs of F’ (derivative of the frequency shift with respect to time) with respect to time at different silver ion concentrations (from a to f: 1 μM, 100 nM, 10 nM, 1 nM, 100 pM, and 0 M) in DI water. (b) Calculated slope from (a) with respect to concentration of Ag^+ (10^6, 10^5, 10^4, 10^3,10^2 and 0 (control)) in DI water and drinking water. Linear slopes were derived from first 5 min of F’.

Selectivity test in drinking water

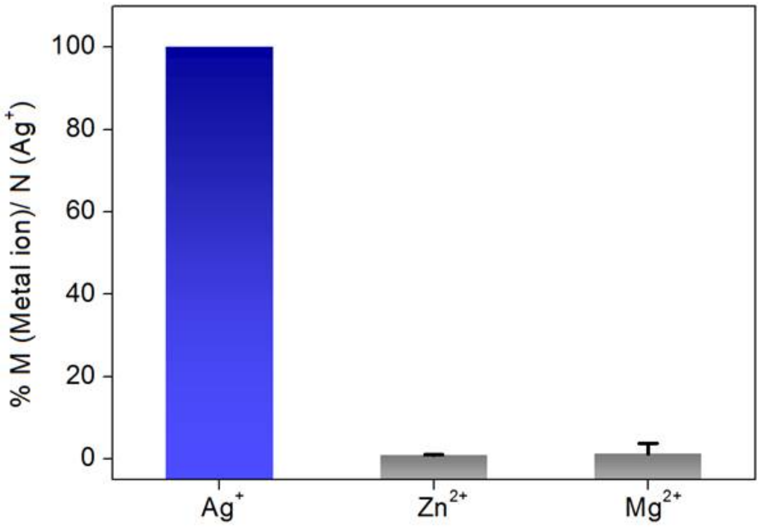

Figure S5. Analysis of Ag$^+$ ion selectivity in drinking water sample. The concentrations of Ag$^+$ ions (blue bar) and all other interfering metal ions (gray bars) were 1 μM. For the statistical data, we measured 5 different QCM data for each ion. The error bar indicates the standard deviation.

Reference

1. Sauerbrey, G. Verwendung von Schwingquarzen zur Wägung dünner Schichten und zur Mikrowägung. *Z. Physik* **1959,** *155* (2), 206-222.