

## **Supporting Information**

### **Electrochemical Detection of Single *E. coli* Bacteria Labeled with**

### **Silver Nanoparticles**

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**Absorption spectra of 10 nM AgNPs with different *E. coli* concentrations.**

*AgNPs were synthesized as follow: 20 mL of 1% (w/v) trisodium citrate solution and 75 mL of ultrapure water were heated to 70 °C for 15 min. 1.7 mL of 1% (w/v) silver nitrate solution and 2 mL of freshly prepared 0.1% (w/v) sodium borohydrate were added rapidly to the heated solution. The mixture was stirred vigorously for another hour at 70 °C. After cooling to room temperature, ultrapure water was added to make the final volume of the nanoparticle suspension 100 mL. A total silver concentration of 1 mM was obtained (~40 nM of AgNPs with mean diameter of 9.4nm).*

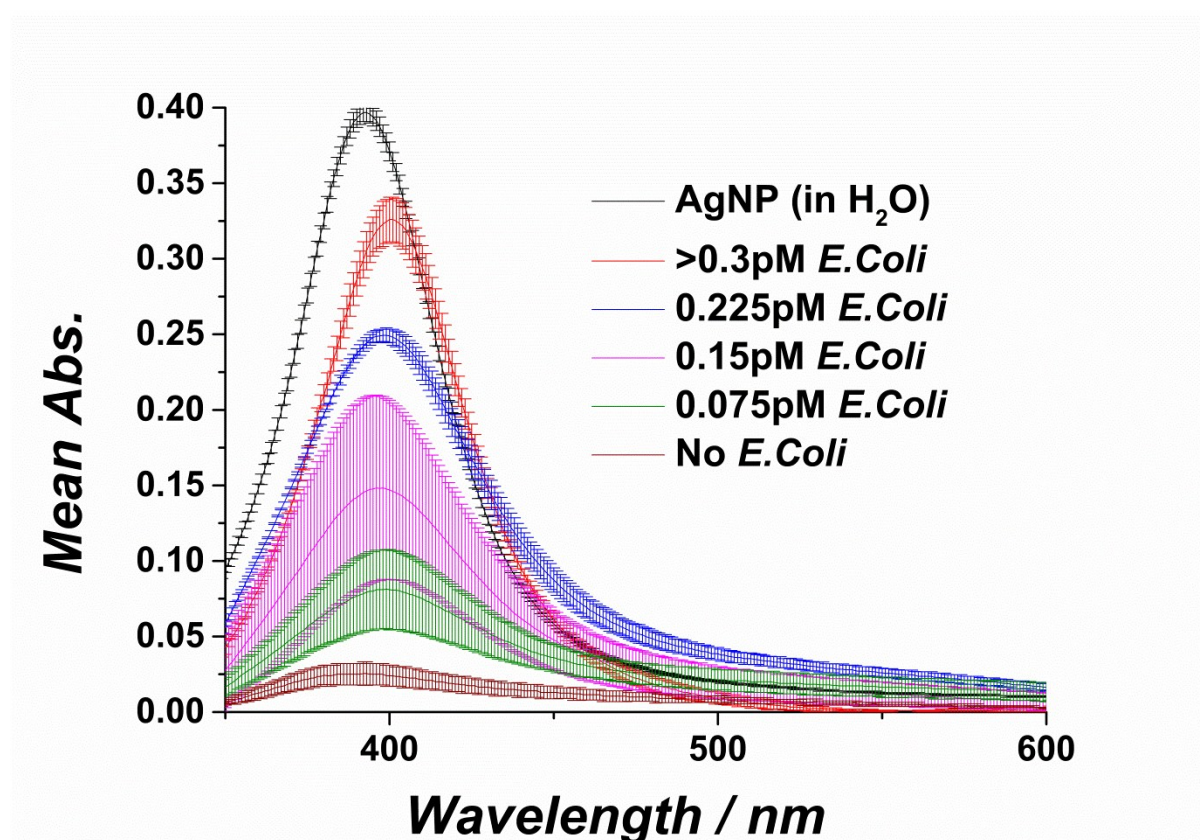
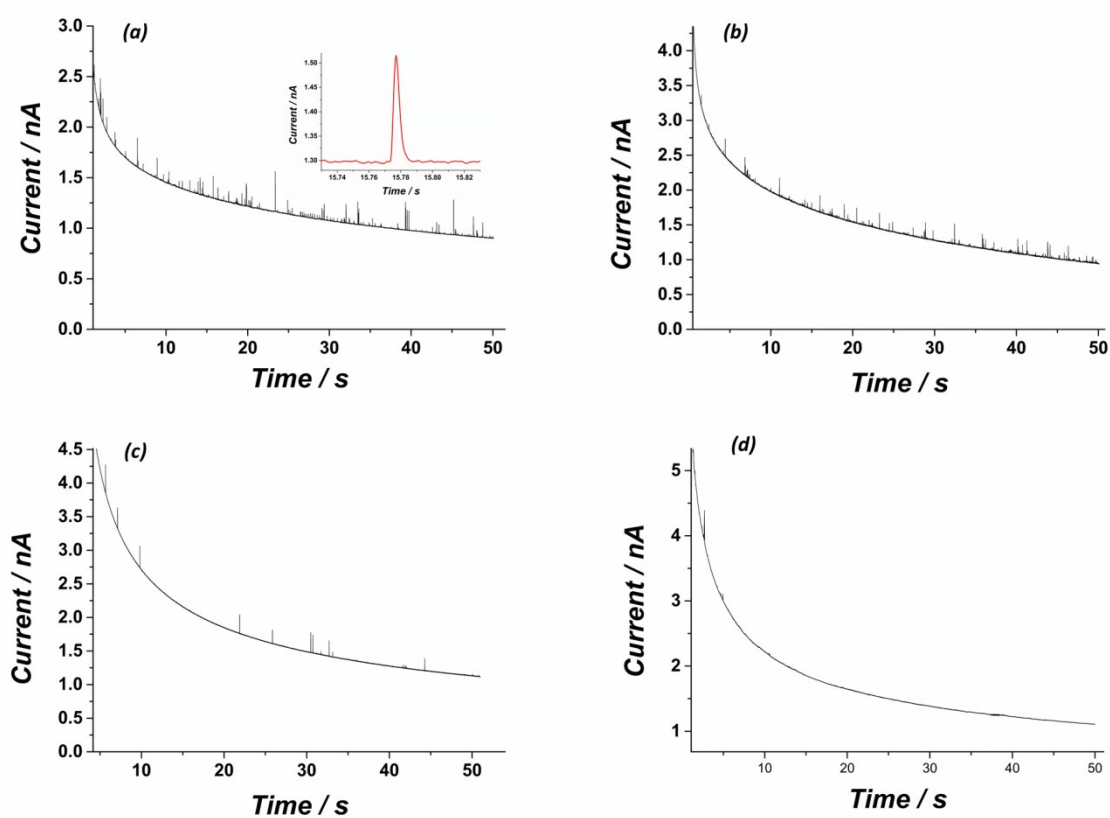


Fig. S1 Absorption spectra of 10 nM AgNPs in water (black), in 0.1 M KCl solution (brown) and after mixing with 0.1 M KCl solution containing different concentrations of *E. coli* cells (0.075 - 0.3 pM).

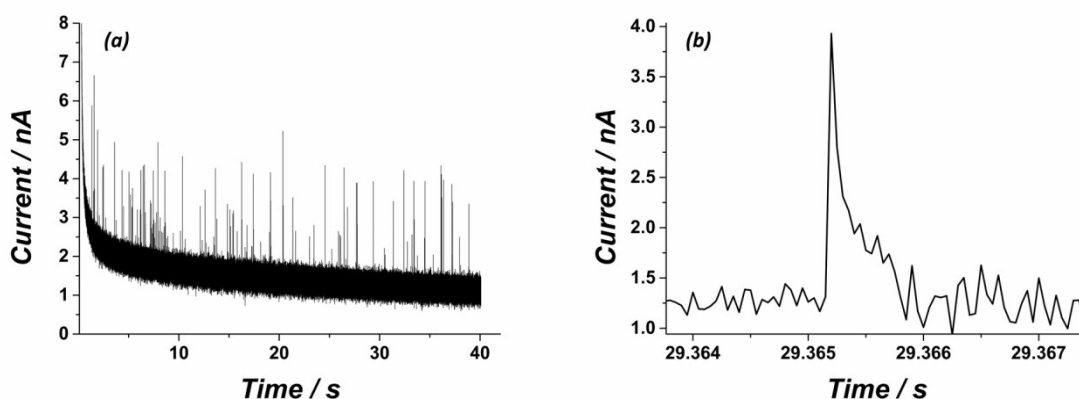
**Chronoamperometric measurements at different *E. coli* concentrations.**



**Fig. S2.** Representative chronoamperometric responses for a carbon fiber electrode potentiostated at +1.3 V vs. SCE in 0.1 M KCl (a) with approximately 3 pM *E. coli* and 10 nM AgNPs. (inset) current spikes seen with expanded time scale. (b) with approximately 1.5 pM *E. coli* and 5 nM AgNPs. (c) with approximately 0.3 pM *E. coli* and 1 nM AgNPs. (d) random current spikes seen for the blank solution containing 10 nM AgNP without *E. coli*, 2 min after AgNP injection. The spikes rapidly disappeared, in less than 10 min.

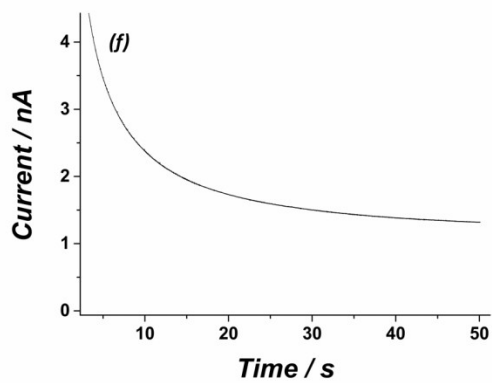
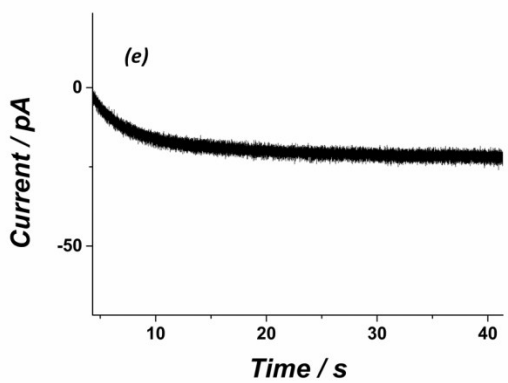
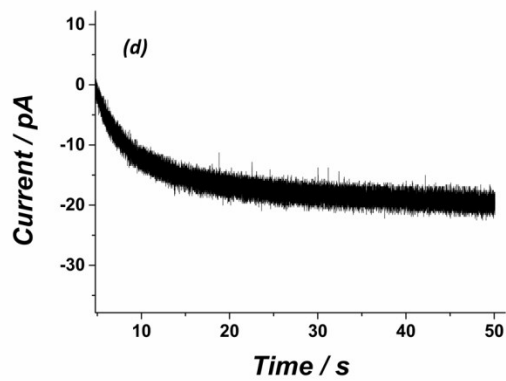
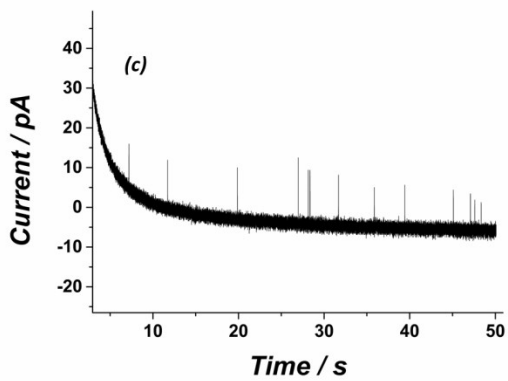
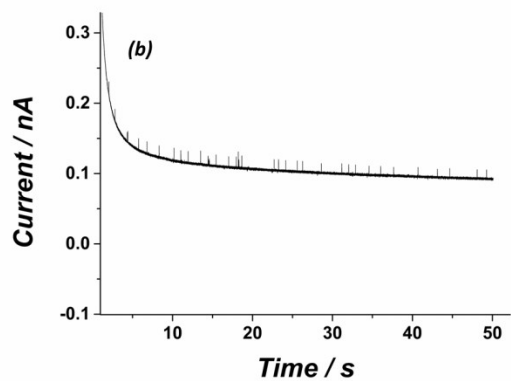
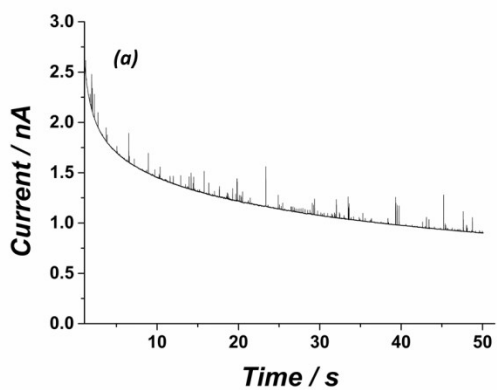
### High bandwidth Chronoamperometric measurements.

As can be seen from **Figure 2b**, the current response occurs within 10 ms duration (limited by the pre-amplifier). This corresponds to a 100 Hz recording bandwidth. Increasing the bandwidth to 10 KHz produced spikes with a higher current magnitude in comparison to the current spikes measured at 100 Hz recording, as expected. The frequency and the total charge of the spike were unchanged. However, by increasing the bandwidth to 10 KHz, the dynamics of the process was resolved, and was estimated to be  $790 \pm 230 \mu\text{sec}$ .



**Fig. S3.** Resolving impact time: Current-time plots measured of 10 nM AgNPs in 3 pM *E. coli* (0.1 M KCl), with a bandwidth of 10 KHz recording time. (a) 40 sec scan. (b) Representative spike at expended time scale.

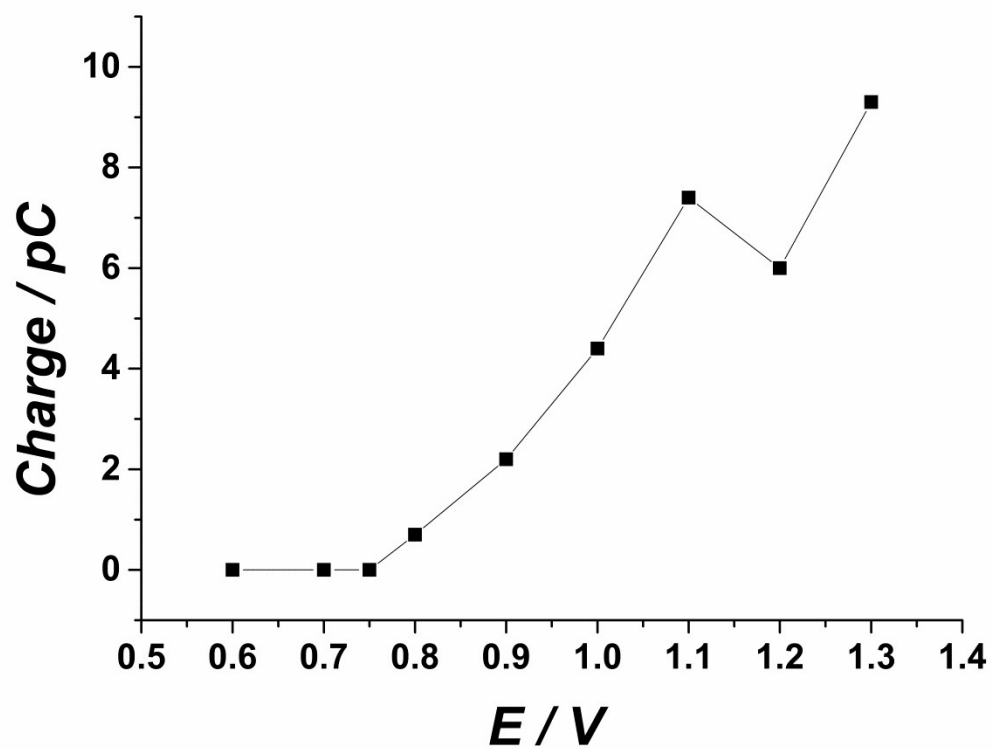
Chronoamperometric measurements at different applied potentials.



**Fig. S4.** Chronoamperometric measurements at different applied potentials of (a) 1.3 V, (b) 0.9 V, (c) 0.6 V, (d) 0.4 V and (e) 0.35 V vs. SCE. (f) Chronoamperometric measurement of bacterial solution with AgNP at 1.3 V vs. SCE after 0.2  $\mu\text{m}$  filtration. In the case of solution containing *E. coli* cells without AgNPs, spikeless chronoamperometric signal was observed, similar to the blank solution (without *E. coli*) and after filtration.

**Measured average charge transferred at high AgNPs:*E. coli* ratio (30,000:1).**

The extent of decoration had an effect on the average charge detected during each impact. In the case of 3,000:1 molar ratio (AgNP:*E. coli*), the average charge seen was  $\sim 1.2$  pC. When the molarity ratio was increased to 30,000:1 the average charge detected during each impact increased to 9 pC. This is expected, since the two different cases represent different amount of AgNP attached to the *E. coli* cell. However, at this higher NP concentration electrode fouling also occurred, probably arising from the large amount of AgNPs and/or possibly cell leakage. The electrochemical blocking of the electrode at such concentrations provides an upper limit of AgNPs:*E. coli* ratio that should be used, in analytical investigation.



**Fig. S5.** Measured average charge transferred as a function of the applied electrode potential, for 10 nM AgNPs in 0.3 pM *E. coli* solution. (30000:1 AgNP:*E. coli* molar ratio). At an applied potential of < 0.8 V vs. SCE, no transient current (beside noise level) has been detected.