Electronic Supplementary Information for

Antibacterial performance of polymer quaternary ammonium salt - capped silver nanoparticles on *Bacillus subtilis* in water

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Supplementary information captions:

Fig. S1 The physicochemical properties of PVP-AgNPs. (a) UV–visible spectrum; (b) TEM image.

Fig. S2 Inactivation efficiency of *B. subtilis* with silver ions corresponding to different release from 1.0 mg/L of PQAS-AgNPs or PVP-AgNPs. Reaction conditions: reaction time = 60 min, T = 25 °C, initial concentration of *B. subtilis*: $10^6$ CFU/mL.

Fig. S3 Inactivation efficiency of *B. subtilis* with silver ions corresponding to different pH values (pH = 4.9, 7.1, 8.9). Reaction conditions: reaction time = 60 min, T = 25 °C, initial concentration of *B. subtilis*: $10^6$ CFU/mL.

Fig. S4 Effect of Cl$^-$ on antibacterial efficacy to *B. subtilis* of PQAS. Reaction conditions: [PQAS] = 1.0 mg/L, contact time = 60 min, pH = 7.1, T = 25 °C, initial concentration of *B. subtilis*: $10^6$ CFU/mL.

Fig. S5 Effect of Cl$^-$ on antibacterial efficacy to *B. subtilis* of PVP-AgNPs. Reaction conditions: [AgNPs] = 10.0 mg/L, contact time = 60 min, pH = 7.1, T = 25 °C, initial concentration of *B. subtilis*: $10^6$ CFU/mL.

Fig. S6 Effect of HA on antibacterial efficacy to *B. subtilis* of PVP-AgNPs. Reaction conditions: [AgNPs] = 10.0 mg/L, contact time = 60 min, pH = 7.1, T = 25 °C, initial concentration of *B. subtilis*: $10^6$ CFU/mL.

Fig. S7 FCM results of *B. subtilis* after treated by PVP-AgNPs. Among them, (a) to (d) represent the concentration of PVP-AgNPs is 1.0, 2.0, 5.0, 10.0 mg/L, respectively. Reaction conditions: reaction time = 15 min, pH = 7.1, T = 25 °C, initial concentration of *B. subtilis*: $10^6$ CFU/mL.
**Fig. S8** FCM results statistics of *B. subtilis* after treated by PQAS-AgNPs and PVP-AgNPs. Reaction conditions: reaction time = 15 min, pH = 7.1, T = 25 °C, initial concentration of *B. subtilis*: 10⁶ CFU/mL.

**Fig. S9** Changes of ATP of *B. subtilis* after treated by PVP-AgNPs. Reaction conditions: reaction time = 15 min, pH = 7.1, T = 25 °C, initial concentration of *B. subtilis*: 10⁶ CFU/mL.

**Fig. S10** ATP results statistics of *B. subtilis* after treated by PQAS-AgNPs and PVP-AgNPs. Reaction conditions: reaction time = 15 min, pH = 7.1, T = 25 °C, initial concentration of *B. subtilis*: 10⁶ CFU/mL.
Fig. S1
Fig. S2

![Graph showing inactivation rate vs. silver ions (μg/L)]
Fig. S3

![Graph showing inactivation rate vs. Silver ions (μg/L)]

- X-axis: Silver ions (μg/L)
- Y-axis: Inactivation rate (ln(Nf/N))
Fig. S4

Inactivation rate $\lg \left( \frac{N_0}{N} \right)$ vs. Time (min)
Fig. S5
Fig. S6

- Inactivation rate (log(N0/N)) vs. time (min)
- Different concentrations: 0 mg/L, 1.0 mg/L, 5.0 mg/L, 10.0 mg/L, 20.0 mg/L
Fig. S8

![Graph showing the concentration of antibacterial material (mg/L) vs. dead/live bacteria ratio. The graph compares PQAS-AgNPs and PVP-AgNPs.]