Supplementary Information

The interaction between lysozyme and bacillus subtilis by Raman measurement As previous reports demonstrated that the OH oscillators between the water molecules disturbed by different mediums can be identified through the Raman shift.¹ which suggested that the Raman spectroscopy can be used to investigate the interaction between bacillus subtilis and lysozyme. The Raman band of the hydrogen bond (O^{...}H) stretching for liquid water was in the region 2800-3800 cm⁻¹, and the ratio of I_{3400}/I_{3200} was calculated to describe the OH oscillators of the water molecules. Fig. S1 presented the Raman shift of the bacillus subtilis solution without and with lysozyme in the range 2800-4000 cm⁻¹. In the absence of lysozyme, the value of I_{3400}/I_{3200} was calculated to be 0.9, which was a good consistent with the value of 0.87 reported by Luu and co-workers.² It was suggested that the bacillus subtilis has no significant effect on the OH oscillators between the water molecules. While the I₃₄₀₀/I₃₂₀₀ ratio increased apparently (which was equal to 1.17, and higher than 1.0) when lysozyme existed in the bacillus subtilis solution, which revealed that the intermolecular coupling of the OH oscillators between the water molecules was reduced. The reason may attributed to the fact that lysozyme absorbed onto the surfaces of bacillus subtilis, destroyed their cell wall, and released an amount of intracellular amino acid residues that can interact with water molecules by hydrogen bond, cansed the decrease of the OH oscillators between the water molecules. It was indicated that lysozyme appended onto the surfaces of bacillus subtilis successfully.



Fig. S1. Raman spectrum of different solutions, (a) the bacillus subtilis solution; (b) the mixed solution containing bacillus subtilis and lysozyme. Concentrations of bacillus subtilis and lysozyme were 1.5×10^5 CFU/mL and 1.0μ g/mL, respectively.



Figure S2. TEM image of the AuNPs solution.



Fig. S3 Impact of lysozyme concentration on the value of A_{521}/A_{602} ratio, where A_{521} and A_{602} indicated the UV/Vis absorption intensities at 521 nm and 602 nm, respectively. The bacillus subtilis concentration was 1.5×10^5 CFU/mL.

Table S1. ζ potential measurement of AuNPs solution in different conditions*

Number	a	b	c
ζ potential (mV)	-23.39	-11.47	-21.95

(a) The AuNPs solution; (b) Lysozyme-capped AuNPs solution; (c) Lysozyme-capped AuNPs solution with the addition of bacillus subtilis of 1.5×10^5 CFU/mL.

Reference

1 A. Joachimiak, T. Halamus, P. Wojciechowski and J. Ulanski, *Macromol. Chem. Phys.* 2005, **20**6, 59-65.

2 D. V. Luu, L. Cambon and M. Mathlouthi, J. Mol. Struct. 237, 1990, 411-419.