

Supporting Information for

Melamine-promoted formation of bright and stable DNA-silver nanoclusters and their antimicrobial properties

Hyunmin Eun,^{#,a} Woo Young Kwon,^{#,a} Kalimuth Kalishwaralal,^a Yonghwan Kim,^b Miran Lee,^b Jung-Oh Ahn,^c Hongweon Lee,^c Sang Hyun Lee,^a Hyung Joo Kim,^a Hyun Gyu Park^d and Ki Soo Park^{a,*}

[#] These authors equally contributed to this work.

^a Department of Biological Engineering, College of Engineering, Konkuk University, Seoul 05029, Republic of Korea

^b Daisung Green Tech, Gyeonggi-do 13216, Republic of Korea

^c Biotechnology Process Engineering Center, Korea Research Institute Bioscience Biotechnology (KRIBB), Gwahangno, Yuseong-Gu, Daejeon 305-806, Republic of Korea

^d Department of Chemical and Biomolecular Engineering (BK21+ Program), KAIST, Daehak-ro 291, Yuseong-gu, Daejeon 305-338, Republic of Korea

* To whom correspondence should be addressed.

E-mail: kskonkuk@gmail.com; Phone: +82-450-3742; Fax: +82-450-3742

Table S1. DNA sequences employed to prepare DNA-AgNCs and their excitation and emission maximum wavelengths.

Strand name	DNA sequence (5' - 3')	Excitation	Emission
Seq A	CCCTTAATCCCC	597 nm	670 nm
Seq B	CCCTAACTCCCC	650 nm	720 nm
Seq C	CCCCCCCCCCCC	545 nm	630 nm
Seq D	CCTCCTTCCTCC	555 nm	630 nm
Seq E	AGGTCGCCGCCC	575 nm	650 nm

Table S2. The amount of silver in DNA-AgNCs and Mel-DNA-AgNCs.

	Concentration of silver (ppm)
DNA-AgNCs	6.36±0.46
Mel-DNA-AgNCs	7.9±1.10

Table S3. Comparison of this method with previous ones to improve the fluorescence properties of DNA-AgNCs.

Key component/principles	Advantages	Disadvantages	Reference
Triplex DNA	- No additional chemicals	- Triplex DNA is hard to form and labile to pH and temperature	[a]
Molecular crowding effect	- Easy synthesis - Universal application to different DNA sequences	- The enhancement of fluorescence properties is not that significant	[b]
Thiol-labeled DNA	- Easy synthesis	- Expensive chemical modification of DNA template	[c]
Poly-cytosine hairpin DNA	- Easy synthesis	- The enhancement of fluorescence properties is not that significant	[d]
Protein–DNA interaction	- Easy synthesis - Universal application to different DNA sequences	- Requirement of expensive proteins that are labile to pH and temperature	[e]
Melamine–DNA interaction	- Easy synthesis - Significant enhancement of fluorescence properties	-	This work

[a] L. Feng, Z. Huang, J. Ren and X. Qu, *Nucleic Acids Research*, 2012, **40**, e122–e122.

[b] Z. Huang, J. Ren, W. Yang and X. Qu, *Chem. Commun.*, 2013, **49**, 10856–3.

[c] X. Zhang, Y. Qian, X. Ma, M. Xia, S. Li and Y. Zhang, *Nanoscale*, 2018, **10**, 76–81.

[d] P. R. O’Neill, L. R. Velazquez, D. G. Dunn, E. G. Gwinn and D. K. Fygenson, *J. Phys. Chem. C*, 2009, **113**, 4229–4233.

[e] Z. Zhou and S. Dong, *Nanoscale*, 2015, **7**, 1296–1300.

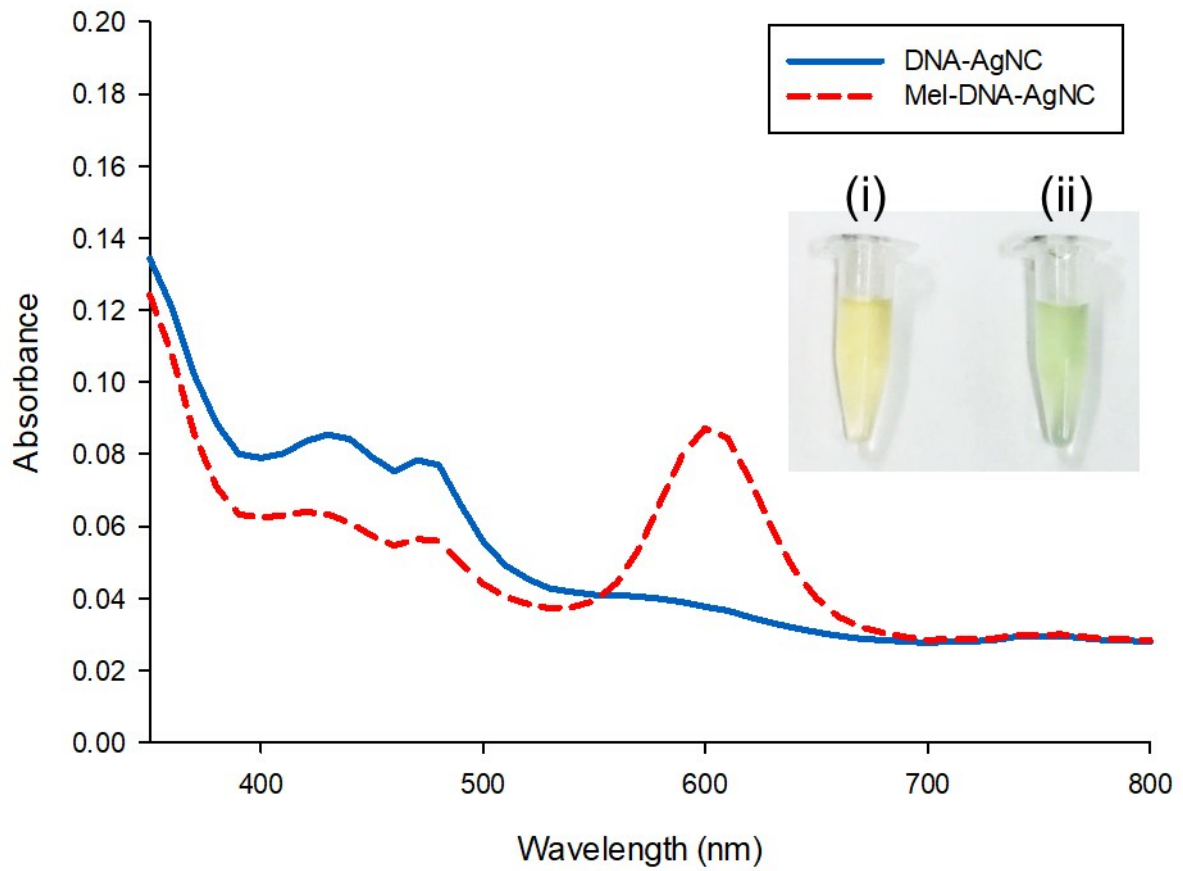


Figure S1. Absorption spectra of DNA-AgNCs (blue line) and Mel-DNA-AgNCs (red line). The inset photographs show DNA-AgNCs (i) and Mel-DNA-AgNCs (ii) under visible light.

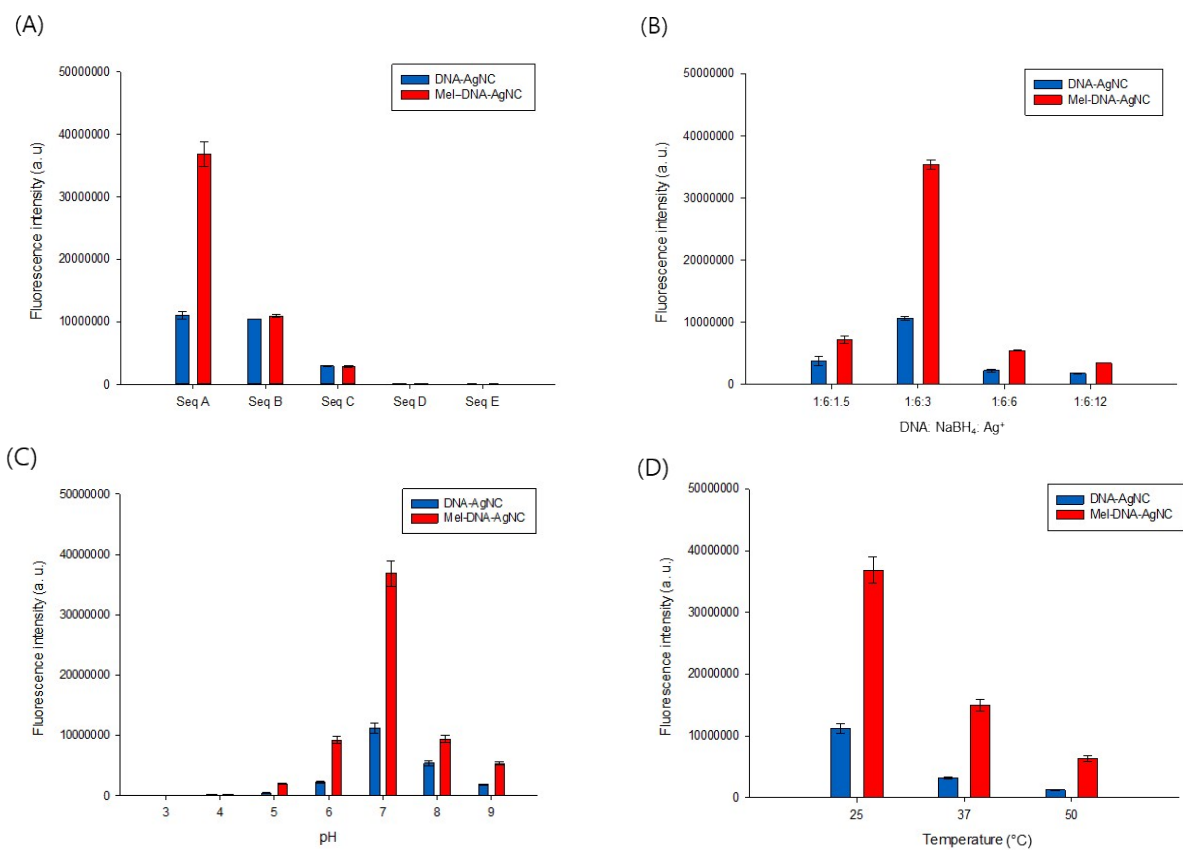


Figure S2. Optimization of reaction conditions. Effects of DNA template (A), the molar ratio of DNA:Ag⁺:NaBH₄ (B), pH (C), and temperature (D) on the melamine-promoted fluorescence enhancement of DNA-AgNCs.

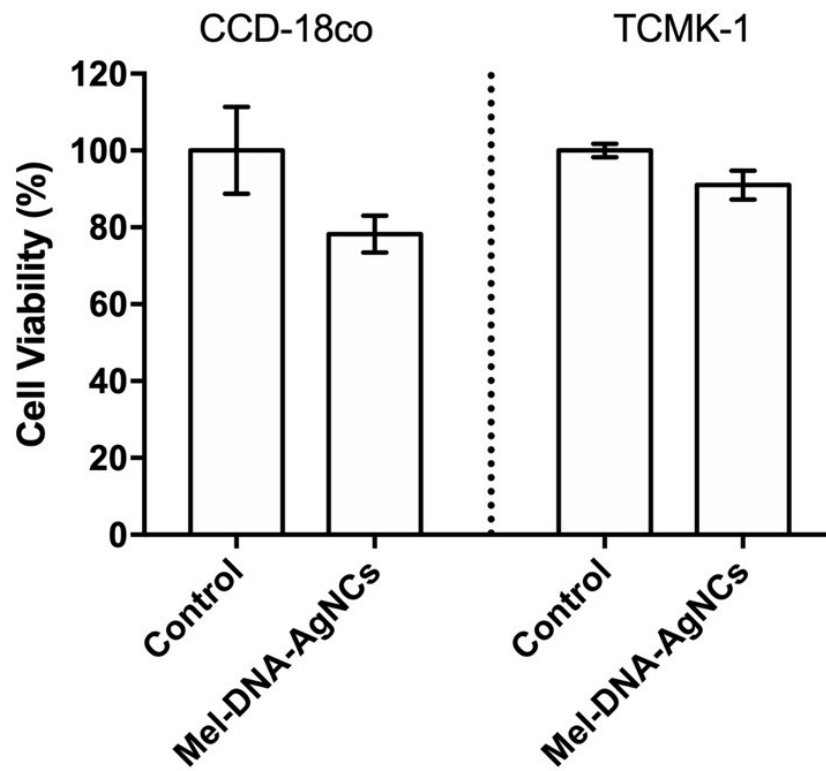


Figure S3. Cytotoxicities of Mel-DNA-AgNCs against TCMK-1 (Mus kidney normal) and CCD-18co (Homo sapiens colon normal).