

Electronic Supplementary Information (ESI)

Kelvin probe force microscopy of DNA-capped nanoparticles for single-nucleotide polymorphism detection

Hyungbeen Lee,^{‡a} Sang Won Lee,^{‡b} Gyudo Lee,^c Wonseok Lee,^a Jeong Hoon Lee,^d

Kyo Seon Hwang,^e Jaemoon Yang,^f Sang Woo Lee,^{*a} and Dae Sung Yoon^{*b}

^a Department of Biomedical Engineering, Yonsei University, Wonju 26493, Korea

E-mail: yusuklee@yonsei.ac.kr

^b Department of Bio-convergence Engineering, Korea University, Seoul 02841, Korea

E-mail: dsyoon@korea.ac.kr

^c School of Public Health, Harvard University, Boston, Massachusetts 02115, USA

^d Department of Electrical Engineering, Kwangwoon University, Seoul 01897, Korea

^e Center for Biomicrosystem, Korea Institute of Science and Technology (KIST), Seoul 02792, Korea

^f Department of Radiology, Yonsei University College of Medicine, Seoul 03722, Korea

[‡] These authors contributed equally to this work.

Estimation of the number of DNA immobilized on a gold nanoparticle (AuNP)

The surface area ($A = 4\pi R^2$, where R is the particle radius) of AuNP (100 nm in diameter) is 31,400 nm² and we assumed that the surface area required for placing the oligonucleotide (5'-CAG AAA AAA AAG GTA G -3') would be approximately 4 × 4 nm², considering the steric hindrance due to the length of the oligonucleotide although the diameter of single stranded DNA is ~1 nm. Our estimation (~2000 DNA molecules on the surface of a AuNP) is also consistent with the previous studies (H. D. Hill et al., *ACS Nano*, 2009, **3**, 418-424). Because the chain length of oligomers is nearly similar to ones used in those studies, we thought that our calculation is reasonable as long as we follow their protocol for DNA functionalization on AuNP.

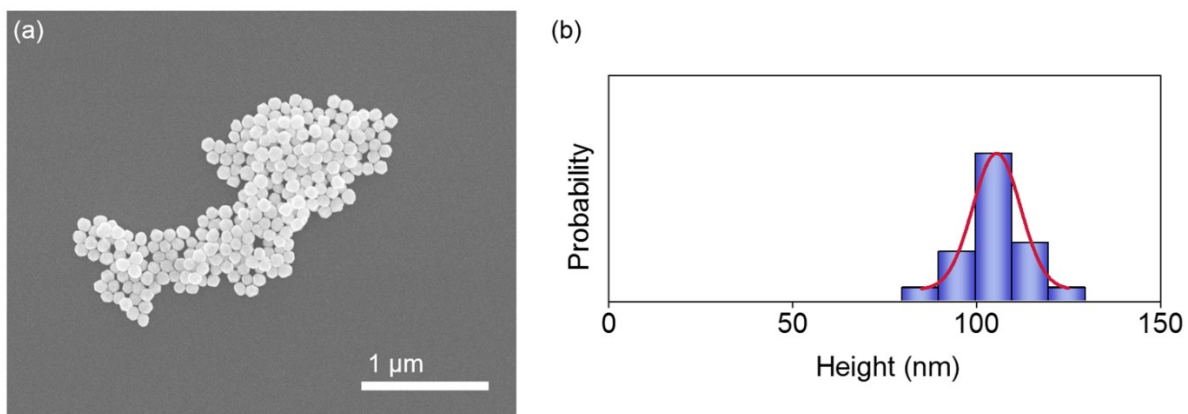


Figure S1. (a) A SEM image of the bare gold nanoparticles (AuNPs) and (b) the corresponding height distribution with a best-fit Gaussian curve (105.45 ± 7.82 nm; mean \pm standard deviation; $R^2 = 0.99$).

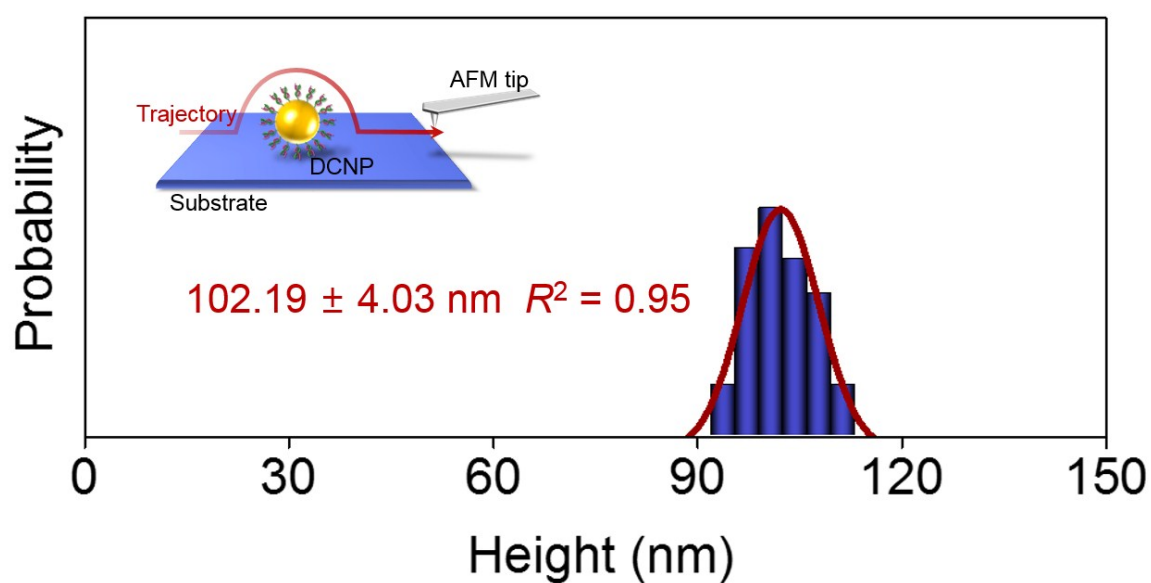


Figure S2. Gaussian distribution of the P-C DCNP height on all substrates with a Gaussian fit (102.19 ± 4.03 nm; mean \pm standard deviation; $R^2 = 0.95$).

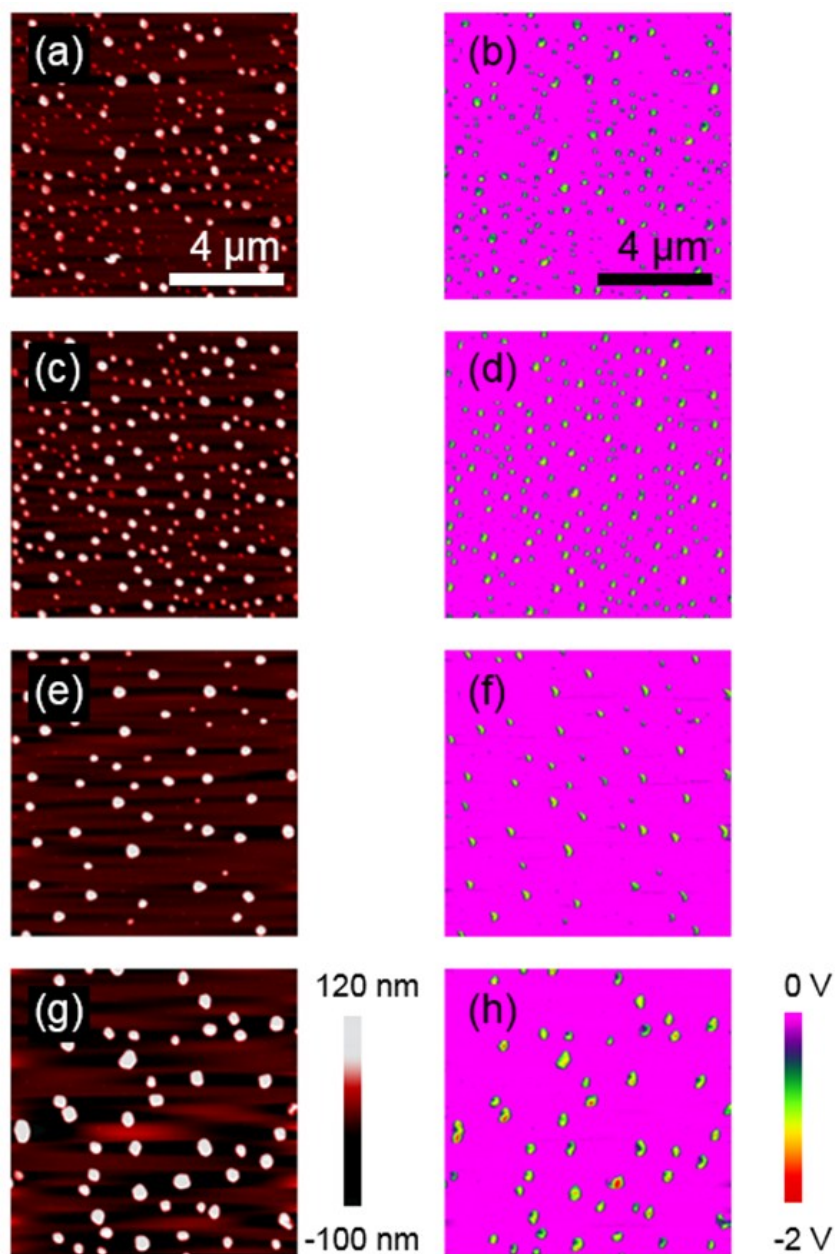


Figure S3. AFM topographic images (a,c,e,g) and SP images (b,d,f, h) of the DCNPs on four different types of substrates: (a,b) Au substrate; (c,d) P-type Si substrate; (e,f) SiO₂ substrate; and (g,h) Fe substrate. (Image size: $10 \times 10 \mu\text{m}^2$).

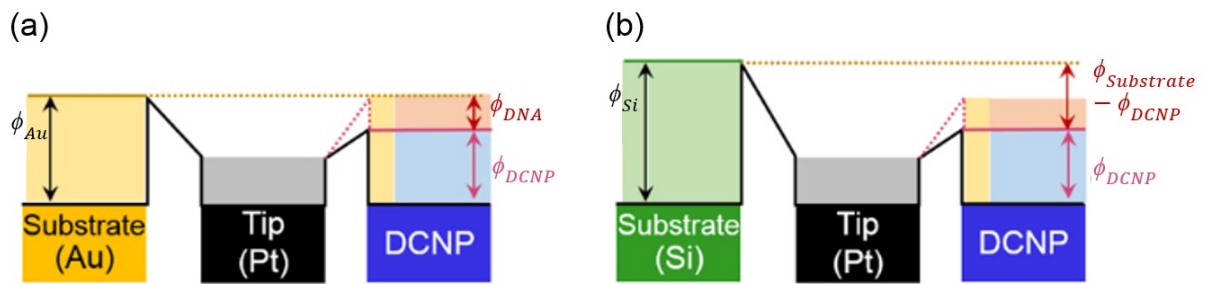


Figure S4. Kelvin probe energy diagram, used for measuring Volta potential between substrate, DCNP, and AFM tip with the Au substrate (a) and p-type Si substrate (b).