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## Asia 3 Roundtable on Nucleic Acids 2024

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2008- Present Professor, Sogang University  
2018 Visiting Professor, Kyoto University  
2006-2008 Postdoctoral Researcher, University of Illinois at Urbana-Champaign, USA  
2006 PhD University of Wisconsin-Madison, USA  
1995~2001 Samsung Advanced Institute of Technology  
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#### Research Interests:

Single-molecule DNA Analysis, Optical Mapping, Microfluidics, Electron Microscopy

#### Selected Publications:

1. Noh C, Kang Y, Heo S, Kim T, Kim H, Chang J, Sundhar baabu PR, Shim S, Lim K, **Lee J\***, **Jo K\***, SEM Imaging of Large DNA Molecules Using a Metal-Free Electro-Stain Composed of DNA-Binding Proteins and Synthetic Polymers, *Advanced Science* **2024**, 11(28), 2309702
2. Lee Y, Cho CH, Noh C, Yang JH, Park SI, Lee YM, West JA, Bhattachaya D, **Jo K\***, Yoon HS\*, Origin of minicircular mitochondrial genomes in red algae, *Nature Commun*, **2023**, 14, 3363
3. Bong S, Park CB, Cho S, Bae J, Hapsari, ND, Jin X, Heo S, Lee J, Hashiya K, Bando T, Sugiyama H, Jung K\*, Sung BJ\*, **Jo K\***, AT-specific DNA visualization revisits the directionality of bacteriophage  $\lambda$  DNA ejection, *Nucleic Acids Research*, **2023**, 51, 5634
4. Jin X, Kannappanb S, Hapsari ND, Jin Y, Kim KK\*, Lee JH\*, **Jo K\***, Towards Visualizing Genomic DNA Using Electron Microscopy via DNA Metallization, *Small Structures*, **2023**, 4(8), 2200361
5. Jin Y, Bae J, Kim T, Hwang H, Kim T, Yu M, Oh H, Hashiya K, Bando T, Sugiyama H, **Jo K\***, 12 Colors of Streptavidin-Fluorescent Proteins (SA-FP): A Versatile Tool to Visualize Genetic Information in Single-Molecule DNA, *Anal Chem*, **2022**, 94, 48, 16919

# SEM Imaging of Large DNA Molecules

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## Abstract

I would like to introduce scanning electron microscopy (SEM)-based DNA imaging in biological samples (*Advanced Science* **2024**, 11(28), 2309702). Our novel approach incorporates a metal-free electro-stain reagent, formulated by combining DNA-binding proteins and synthetic polymers, to enhance the visibility of 2-nm-thick DNA under SEM. Notably, DNA molecules stained with these proteins and polymers appear as dark lines under SEM. The resulting images exhibit a DNA thickness of  $15.0\pm 4.0$  nm. As SEM is the primary platform, it integrates seamlessly with various chemically functionalized large surfaces using microfluidic devices. This approach enables high-resolution imaging of diverse DNA structures, including linear, circular, and single-stranded DNA and RNA, derived from both nuclear and mitochondrial genomes. Furthermore, quantum dots are successfully visualized as bright labels that are sequence-specifically incorporated into DNA molecules, highlighting the potential for SEM-based optical DNA mapping (SOM). In conclusion, DNA imaging using SEM with this novel electro-stain provides electron microscopy resolution with the simplicity of optical microscopy.

1. Noh C, Kang Y, Heo S, Kim T, Kim H, Chang J, Sundhar baabu PR, Shim S, Lim K, Lee J\*, Jo K\*, SEM Imaging of Large DNA Molecules Using a Metal-Free Electro-Stain Composed of DNA-Binding Proteins and Synthetic Polymers, *Advanced Science* **2024**, 11(28), 2309702