Selenium Nucleic Acids for Innovative Structural Biology

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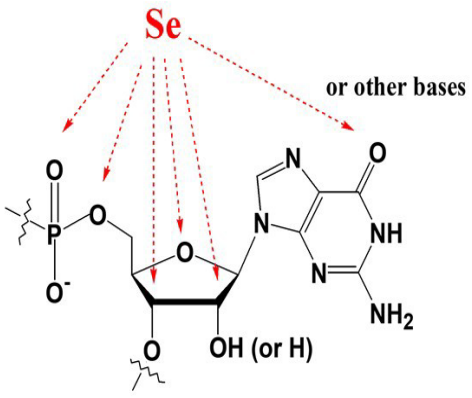
Nucleic acids play important roles in life processes, such as genetic material, gene regulation, signaling, catalysis, and viral infection. Nucleic acids are considered as ones of the keys to understand the cellular functions and disease mechanisms. nucleic acid structure biology, especially RNA X-ray crystallography, can greatly accelerate the studies of nucleic acid-protein structures, functions and mechanisms. However, due to the crystallization, heavy-atom derivatization and phase determination, X-ray crystallography of nucleic acids (such as RNAs) is challenging and the structures of many nucleic acids and their protein complexes haven't been resolved. To address these challenges, we have developed the selenium-atom specifically derivatized nucleic acids (SeNA), which can not only enhance the derivatization and diffraction phase determination, but also facilitate crystal growth without significant structure perturbation. This method has huge advantages over the traditional methods, such halogen derivatizations, heavy-metal socking, and molecular replacement. Our presentation will focus on the most recent results on selenium nucleic acid (a new paradim of nucleic acids) and its potential applications in 3D structure- and-function studies, drug discovery, genetic code/codon re-design, bio-informatics, and therapeutic development in molecular diagnostics and medicines, including antisense, siRNA and other potential nucleic drugs.
Selected Publications (out of 131):

Refernces
{1} Shun Zhang, Ling Tang, Jun Zhang, Wen Sun, Dan Liu, Jiuyi Chen, Bei Hu, Zhen Huang, "Single-atom-directed inhibition of de novo DNA synthesis in isothermal amplifications", Analytical Chemistry, 2022, 94, 15763-15771..*
{2} Shichao Sun, Dejin Xu, Lin Zhu, Bei Hu and Zhen Huang*, A Programmable, DNA- Exclusively-Guided Argonaute DNase and Its Higher Cleavage Specificity Achieved by 5'-Hydroxylated Guide, Biomolecules, 2022, 12, 1340.*
{3} Jiazhen Lyu, Mei Yang, Chong Zhang, Yongbo Luo, Tong Qin, Zhaoming Su, and Zhen Huang, "DNA nanostructures directed by RNA clamps", Nanoscale, 2021, 13, 19870- 19874.*
{4} Bei Hu, Yitao Wang, Shichao Sun, Guangcheng Luo, Shun Zhang, Jun Zhang, Lu Chen, Zhen Huang, "Specificity enhancement of DNA polymerization for sensitive nucleic acid detection", Analytical Chemistry, 2020, 92, 15872-15879.*
{5} Bei Hu, Yitao Wang, Shichao Sun, Weizhu Yan, Chong Zhang, Danyan Luo, Deng, Lillian R. Hu, Zhen Huang, "Synthesis of Selenium-triphosphates (dNTPaSe) for morespecific DNA polymerization", Angew. Chem. Int. Ed., 2019, 58, 7835-7839.*
{6} Yiqing Chen, Hehua Liu, Chun Yang, Yanqing Gao, Xiang Yu, Xi Chen, Ruixue Cui, Lina Zheng, Suhua Li, Xuhang Li, Jinbiao Ma, Zhen Huang, Jixi Li* and Jianhua Gan*, "Structure of the error-prone DNA ligase of African swine fever virus identifies critical active site residues", Nature Communications, 2019, 10, 387.*
{7} Venu Gopal Vandavasi, Blakeley, Keen, Hu, Zhen Huang, Andrey Kovalevsky*, "Temperature-induced replacement of phosphate proton with metal ion captured in neutron structures of A-DNA", Structure, 2018, 26, 1-6.*
{8} Hehua Liu, Xiang Yu, Yiqing Chen, Jing Zhang, Baixing Wu, Lina Zheng, Phensinee Haruehanroengra, Rui Wang, Suhua Li, Jinzhong Lin, Jixi Li, Jia Sheng, Zhen Huang, Jinbiao Ma*, and Jianhua Gan*, "Crystal structure of an RNA-cleaving DNAzyme", Nature Communications, 2017, 8, 2006.*



Selenium-atom-derivatized Nucleic Acids (SeNA)
for Innovative Structural Biology

Figure 1