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2020 - Present Associate Professor, POSTECH
2016-2020 Assistant Professor, POSTECH
2014-2016 Research Fellow, Massachusetts General Hospital/Harvard Medical School
2012-2014 Postdoctoral Researcher, Institute for Collaborative Biotechnologies
2012 PhD University of California, Santa Barbara, U.S.A.
2007 MS Seoul National University, Seoul, Korea
2005 BS Seoul National University, Seoul, Korea

Research Interests:

• Proteomimetics and cytomimetics with sequence-controlled biopolymers
• Generation and applications of molecular recognition elements (**aptamers**), molecular catalysts (**ribozymes/DNAzymes**) and molecular machines (**riboswitches/structure-switching aptamers**)
• Molecular transducers for synthetic biology
• Origins of life

Selected Publications:

1. Aptasensor-encapsulating semi-permeable proteinosomes for direct target detection in non-treated biofluids, ***Biosensors and Bioelectronics***, 251, 116062 (2024)
2. G-quadruplex-filtered selective ion-to-ion current amplification for non-invasive ion monitoring in real time, ***Advanced Materials***, 35, 2303655 (2023)
3. Molecular complementarity of proteomimetic materials for target-specific recognition and recognition-mediated complex functions, ***Advanced Materials***, 35, 2208309 (2023)
4. Type-Independent 3D Writing and Nano-Patterning of Confined Biopolymers, ***Advanced Science***, 10, 2207403 (2023)
5. De novo selected hACE2 mimics that integrate hot-spot peptides with aptameric scaffolds for binding tolerance of SARS-CoV-2 variants, ***Science Advances***, 8, eabq6207 (2022)
6. Live streaming of a single cell's life over a local pH-monitoring nanowire waveguide", ***Nano Letters***, 22, 6375 (2022)
7. Chain flexibility of medicinal lipids determines their selective partitioning into lipid droplets, ***Nature Communications***, 13, 3612 (2022)
8. Metabolite trafficking enables membrane-impermeable-terpene secretion by yeast, ***Nature Communications***, 13, 2605 (2022)

Molecular recognition-guided modification of non-engineered proteins at specific sites

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Abstract

Bioconjugation technologies are rapidly shifting the paradigm of biotechnology and pharmaceuticals. Integration of different biomolecules is highly synergistic; for instance, the potency of drugs embedded in antibody-drug conjugates (ADCs) is dramatically increased than when it acts alone, making the ADCs become a game changer for the treatment of oncology diseases. However, current techniques in bioconjugation reveal several critical limitations as followed. 1) The covalent bond formation is chemo-selective, not site-selective, and typically, 2) site-specific bioconjugation relies on genetically engineered proteins, not native ones. Besides, 3) there can be unexpected conjugation at different sites, and 4) manufacturing complexity and lack of generality can be critical. In this talk, we present an aptamer-mediated, ultra-efficient and site-specific bioconjugation technique highly applicable for non-engineered proteins. As the bioconjugation reagent is composed of reactive moiety (modified base) and targeting carrier (aptamer), it performs a highly programmed action, “ultra-site-specific conjugation by molecular recognition.” In proving the superiority of our molecular recognition-based bioconjugation, we demonstrate its use for non-engineered protein labeling, including the production of homogeneous, well-defined ADCs that can maximize therapeutic efficacy.