
Asia 3 Roundtable on Nucleic Acids 2024

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2010-Present Professor, Okayama University
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Research Interests:

Photo-triggered control of cellular functions, Intracellular delivery of nucleic acids,
RNA imaging, Translation system

Selected Publications:

1. Ikawa Y, Wakai T, Funahashi H, Soe TH, Watanabe K, Ohtsuki T, Photo-dependent cytosolic delivery of shRNA into a single blastomere in a mouse embryo. **Sci. Rep.** 2023; 13: 13050.
2. Kim H, Watanabe S, Kitamatsu M, Watanabe K, Ohtsuki T, Cell cycle dependence of apoptosis photo-triggered using peptide-photosensitizer conjugate. **Sci. Rep.** 2020; 10: 19087.
3. Miyoshi Y, Kadono M, Okazaki S, Nishimura A, Kitamatsu M, Watanabe K, Ohtsuki T, Endosomal escape of peptide-photosensitizer conjugates is affected by amino acid sequences near the photosensitizer. **Bioconjug. Chem.** 2020; 31, 916–922.
4. Shiraga K, Soe T. H, Matsumoto S, Watanabe K, Ohtsuki T, Red and near-infrared light-directed cytosolic delivery of two different RNAs using photosensitive RNA carriers. **Bioconjug. Chem.** 2018; 29, 3174-3179.
5. Ohtsuki T, Kanzaki S, Nishimura S, Kunihiro Y, Sisido M, Watanabe K, Phototriggered protein syntheses by using (7-diethylaminocoumarin-4-yl)methoxycarbonyl- caged aminoacyl tRNAs. **Nat. Commun.** 2016; 7, 12501.

Cell-penetrating peptide/photosensitizer conjugates for photo-triggered cytosolic delivery of RNAs

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Abstract

Here we present examples of photoresponsive molecules that photo-dependently enter the cytoplasm based on the principle of photochemical internalization, and how they have been developed and used. The photoresponsive molecule discussed here is a complex consisting of a photosensitizer, a cell-penetrating peptide, and a cargo molecule (molecule to be delivered into the cytoplasm). When administered to cells, this photoresponsive molecule enters the cell by endocytosis and becomes trapped within endosomes, but when exposed to light, it escapes the endosomes and functions in the cytoplasm. Examples of these molecules include photoresponsive RNA carriers and photoresponsive apoptosis-inducing molecules. Among them, we report a method (Photoinduced Cytosolic Dispersion of RNA (PCDR) method) for cytosolic delivery of small RNA molecules such as short hairpin RNA (shRNA) and microRNA (miRNA) using the photoresponsive RNA carrier. Specifically, we present the mechanism of PCDR, RNA transfection triggered by light of different wavelengths, and spatiotemporally photo-triggered RNAi. In addition, we report on the analysis of cellular functions by photoresponsive complex molecules and discuss their potential for medical applications.