Near-Infrared Light-Absorbing Organic Molecules towards Photothermal Cancer Therapy

([1]*Graduate School of Environmental Science, Hokkaido University, and* [2]*Research Institute for Electronic Science, Hokkaido University.*) ○Kazuya Yoshida,[1] Vasudevanpillai Biju,[1, 2] Yuta, Takano,[1, 2]

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Modern cancer treatment is mainly by surgery, radiation therapy, and chemotherapy. However, the invasion of normal tissues and drug-resistant cancers are often problems. Therefore, alternative and non-invasive treatments are desired. Phototherapy, including photodynamic therapy (PDT) and photothermal therapy (PTT), has attracted attention in cancer treatments because of its advantages, such as locally selective treatment, low invasiveness, minimal side effects, and effectiveness against resistant cancers. PDT is a technique that uses a photosensitizing agent with high tumor affinity and laser irradiation in the presence of oxygen to generate reactive oxygen species (ROS) to cause tumor cell death. However, the efficacy of PDT is greatly affected by tumor hypoxia. In contrast, PTT uses photothermal agents to damage cancer cells by generating thermal energy through light irradiation. The oxygen concentration does not limit its use. The development of organic materials that absorb near-infrared (NIR) light for PTT is preferable in terms of bio-permeability and biodegradability. In this study, we desig and synthesize photo-functional molecules based on sulfone-rosamine (Fig. 1), which absorb and utilize NIR light efficiently. Their photothermal effects are verified, and their molecular dynamics in cancer cells and the photothermal killing effect are revealed.

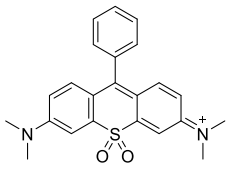

Fig. 1 Thr structure of sulfone-rosamine.

The sulfone-rosamine derivative in Fig. 1 showed the main absorption peak at 704 nm in PBS, indicating its light harvesting ability in the NIR region. After 10 min of a xenon lamp irradiation, the temperature of the solution is increased by 16.2 °C, indicating that the sulfone-rosamine derivative possesses a sufficient photothermal effect. Since there is no change in the absorption spectrum before and after the xenon lamp irradiation (Fig. 2), the sulfone-rosamine derivative is highly photostable. Subcellular localization shows that the sulfone-rosamine derivative is taken up by living cells and is mainly localized in lysosomes. The cell-killing effect of the sulfone-rosamine derivative is also verified, and the results will be presented in the presentation.

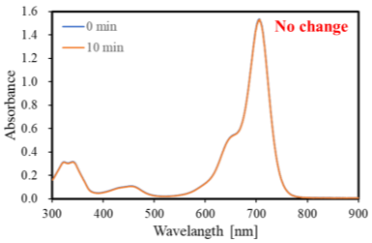

Fig. 2 Absorption spectra of a sulfone-rosamine dye before and after the Xe lamp irradiation (290 mW / spot).

1) L. Li et al. *Chem. Eng. J.* **417**, 128844 (2021).