EFFECTIVE IMAGING PROBES FOR ENZYME/PROTEIN LABELING

Fluorescent/bioluminescent imaging chemistry has currently attracted considerable academic attention in the fields of medicinal chemistry and biological sciences due to its significant detection efficiency, high sensitivity and low cost. Herein, we are aiming to design and synthesize "novel" fluorescent and bioluminescent sensors, which can be used to specifically react with proteins, enzymes or even nucleotides etc. Based on the fluorescent and bioluminescent changes within the bio-reactions, we can sensitively and precisely monitor the bio-functions and screen the drug activities in vitro or in the living systems. (Scheme 1).

DEVELOPMENT OF NANO-PLATFORMS TOWARD BIOMEDICAL APPLICATIONS IN SELECTIVE DRUG DELIVERY, MOLECULAR IMAGING AND BIOCATALYSIS.

Nanomaterials are particularly attractive building blocks for the generation of larger superstructures, which exhibit highly interesting optical, electronic, Raman and magnetic properties and can serve as versatile platforms for exploring many facets in biomedical applications. In this project, we will develop the unique nanomaterials and conjugate them with affinity ligands including bioorganic molecules, peptide substrates or nucleic acid aptamer derivatives etc., which can be applied as biosensors or "transporters" for effective screening/detection of bioactive molecules, efficient drug delivery and biocatalyst or fluorescent monitoring of bio-functions in vitro or in living cells (Scheme 2).

EXTERNAL-STIMULI RESPONSIVE SMALL MOLECULAR WEIGHT SOFT BIOMATERIALS FOR DRUG DELIVERY AND REAL-TIME MONITORING BIOLOGICAL FUNCTIONS.

Through the hydrogen bonding or other weak interactions between the molecules, peptides or polysaccharides can be very readily to form soft-nanomaterial-hydrogel, a brand new functional biomaterials, which is formed by three dimensional and elastic networks with a lot of water filling with the interstitial spaces (Scheme 3). We will design and prepare new bio-responsive hydrogel systems based on peptides, drugs or other natural products which can be selectively released upon the external stimuli. We will also explore their multi-functions in drug delivery, chemical/biological sensors and biocatalysis.

SPECIFIC BIOORGANIC CONJUGATES TOWARD BACTERIAL IMAGING AND MICROBIAL INACTIVATION.

The rapid evolution of conventional antibiotic resistance bacterial species has emerged as a major challenge towards human health. Therefore, development of modified antibiotics derivatives with different mode of actions and the alternative treatment strategies against drug resistant strains are highly required to combat infectious diseases. In this project, we aim to utilize the small molecule antibiotics analogs, lipopolysaccharide and bacterial targeting peptides or aptamers as affinity ligands to multivalently conjugate with photoactive molecules to achieve effective imaging and bacterial inactivation. Meanwhile, we will also investigate the bioprocess and elucidate the mechanisms of action for the antibiotics derivatives in antibacterial studies.