Handcrafted Metal Enzymes as Convenient Reporters in Biosensors

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Leveraging their inherent metal cores, metalloproteins assume pivotal roles in orchestrating intricate natural transformations. This fundamental importance extends to invaluable applications in in vitro diagnostics and biosensing, encompassing immunoassays and electrochemical sensors [1]. Bolstered by recent strides in computational protein design, our endeavors have yielded bespoke enzymes, marking significant milestones in the field [2]. Through diverse strategies, we have crafted compact yet potent models housing multiple metal sites. This exposition shines a spotlight on chosen designs, elucidating their potential within the domain of sensing technology.

We first show that by asymmetrization of the heme environment and precise positioning of the residues at the distal site, with Fe-Mimochrome 6*a (FeMC6*a), we reached unprecedented selectivity in hydrogen peroxide activation leading to a peroxide sensor [3], a catalytic nanoconjugate [4], a signal enhancer in lateral-flow immunoassays [5], and efficient dye degradation for bleaching applications [6]. Finally, we describe our efforts in bioelectronics by coupling a photosensitizing zinc porphyrin with a 3kDa iron-sulphur designed protein, leading to the first fully artificial light-harvested electron cascade [7]. In perspective, our designed metalloproteins will be equipped for the next-generation of biosensors.

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