Handcrafted Metal Enzymes Poised for Biotechnology Revolution

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Thanks to their metal core, metalloproteins play a central role in some of the most difficult transformations in nature. For this reason, they are an invaluable tool in many industrial biotech applications, from denim aging to agricultural feed valorisation[1]. Over the last years, also supported by the recent advances in computational protein design, we have designed several custom-made enzymes, setting several milestones in the field[2]. By different approaches, we designed small, yet functional, models bearing multiple metal sites. In this contribution, some of them will be showcased, highlighting their potential in industrial biotechnology. 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 and to the smallest decolorization enzyme[3]. Then, we show how very small changes, like cobalt replacement in CoMC6*a, may induce a dramatic shift in catalytic activity, towards a high-pH insensitive artificial hydrogenase[4]. Finally, we describe our efforts to couple a photosensitizing zinc porphyrin with a 3kDa iron-sulphur designed protein, leading to the first fully artificial light-harvested electron cascade[5]. In perspective, our designed metalloproteins will be equipped for the biotechnology revolution.

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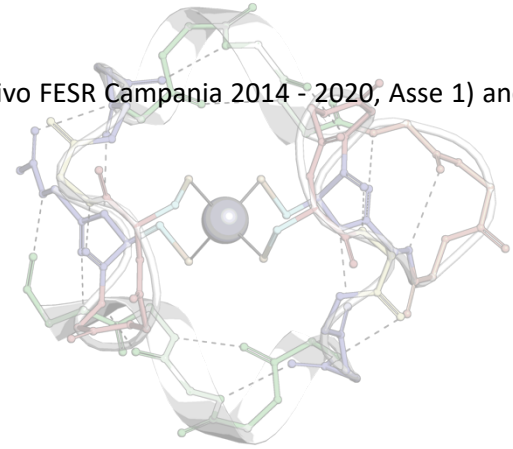

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