Engineering Protein-Nanomaterial Composites: Advanced Tools in Nanomedicine

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The treatment and diagnosis of many diseases still remain a challenge. Inspired by nature, we explore biomolecules and their derivatives as novel therapeutic/diagnostic agents. Among biomolecules, proteins rise huge interest due to their high versatility, biocompatibility, and biodegradability. In particular, we use a class of engineered repeat proteins, the consensus tetratricopeptide repeat (CTPR) proteins due to their stability and robustness as a base scaffold that can be easily tailored to endow desired functions to the protein. For example, the introduction of metal-binding residues (e.g., histidines, cysteines) drives the coordination of metal ions and the subsequent formation of nanomaterials.[1,2] Additionally, new binding capabilities can be encoded within the CTPR unit or this can be conjugated with other peptides/proteins.[3] These properties allow the development of protein-nanomaterial composites.[2,3,4] Generally, the fusion of two distinct materials exploits the best properties of each, however, in protein-nanomaterial composites, the fusion takes on a new dimension as new properties arise.

These composites have ushered the use of protein-based nanomaterials as biopharmaceuticals beyond their original therapeutic scope and paved the way for their use as theranostic agents. In this context, engineered proteins have emerged as promising scaffolds to hold simultaneously therapeutic and diagnostic functions, as has been recently demonstrated in our pioneering in vitro and in vivo examples.[3,4,5]

References

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Figures

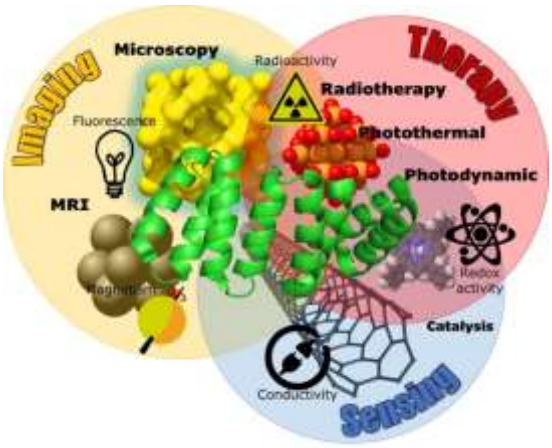

Figure 1. Scheme of engineered protein-nanomaterial composites and potential biomedical fields of application.