Bio-inspired smart materials

Genetically encoded, mussel-inspired bioadhesives for material science and medicine

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In my talk I will introduce orthogonal translation systems (OTS) with genetic code engineering in reprogrammed microbial strains as novel tools in bioinspired materials science. They offer a great potential to make protein-based polymers with spatial and temporal control of their adhesion and other properties. Next, the use of genetically encoded protein-based adhesives as renewable polymers is an economically viable alternative to related synthetic polymers. However, the main obstacle to the *in vivo* recombinant production of mussel foot proteins (Mfps) is the presence of a large amount of non-canonical amino acids (ncAAs) in their functional scaffolds with dihydroxyphenylalanine (DOPA, catechol as the functional group) as a notable example. These amino acids are installed by means of a complex post-translational machinery (PTM) that is not readily available in microbial production strains. The alternative approach would therefore be to incorporate ncAAs of interest directly during translation by an expanded genetic code i.e. to bypass the natural PTMs. In addition, the problem of the spatial-temporal control of the catechol reactivity can be solved by using this system (e.g. adhesive properties being controlled by UV-light). In the context of the recently acquired knowledge of the DOPA role in Mfps, I will provide a short overview of these achievements from the viewpoint of classical chemistry, peptidomimetics, recombinant DNA technology and the most advanced approaches of synthetic biology and xenobiology.

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