BIODEGRADE: Bacteria Intrinsically Orchestrated with Designed Enzymes for sinerGistic Rate-Accelerated plastic Degradation Efficiency

Description

Plastics are one of the most widely used materials, with a wide variety of applications across all sectors of the economy. Its production is estimated to be around 360 million tonnes, and thus synthetic polymer is poorly biodegradable. Plastic life cycle is responsible for greenhouse gas emissions, contributing to climate change, plastic waste has been found in every ecosystem, are broken down into small pieces, microplastics, which can have a negative impact on organisms, and altogether causing an unprecedented ecological crisis.

We aim to tackle this problem through Bacteria Intrinsically Orchestrated with Designed Enzymes for sinerGistic Rate-Accelerated plastic Degradation Efficiency (BIO DEGRADE) project, using a novel application of biotechnological-based approaches to synergistically increase the efficiency limits of multi-enzymatic solutions. The project will perform genomic modification of microorganisms with their own evolved collection of computationally-engineered proteins for (micro)plastic degradation. We are not engineering single enzymes to enhance their catalytic activities, as it will computationally design multitude (hundreds) of proteins from the microorganism, and boost them with extra catalytic sites making them into plurizymes. The additional active sites able to degrade plastics will designed into the proteins employing advanced molecular simulation techniques such Protein Energy Landscape Exploration (PELE) together with machine learning methods. In this way, the proteins will not be from other microbial origin (heterologous), but their homologous proteins, to which an extra active-site capable of hydrolysing microplastics will be designed and genetically added, not altering the gene expression pattern of the microorganisms. These organisms will outperform the use of single enzymes because of the synergistic action of multiple evolved enzymes with one common goal: (micro)plasticdegradation.

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