BIOTRANS
LA ROCHELLE 2023

N°1346 / PC
TOPIC(s) : Enzyme discovery and engineering / Artificial enzymes and de-novo enzyme design

Fusion Proteins for Biocatalyst-Based Polymer Degradation

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PURPOSE OF THE ABSTRACT
Currently, the accumulation of plastic waste due to insufficient/inefficient methods for the degradation of commodity polymers represents a growing environmental problem. In this regard, the use of polymer-degrading biocatalysts has been subject to many studies [1, 2, 3]. Polymers such as polyesters, polyamides, polyurethanes, and polyolefins are highly hydrophobic and water insoluble molecules. However, a biocatalyst needs an aqueous system in order to be active. This difference in hydrophilicity prevents the adsorption of high amounts of biocatalyst to the polymer surface. To maximize biocatalytic efficiency, methods to improve protein-substrate interaction have been explored over the last few years. One possibility represents the fusion of a substrate-binding domain that acts as a plastic-recognition element (a hydrophobic anchor) and increases the protein's binding affinity. Hydrophobins, which are small fungal proteins that self-assemble on lipophilic surfaces, represent one option to enhance substrate binding [4]. In previous research, PET hydrolysis efficiency has been improved by the fusion of hydrophobins to a PET hydrolase [5].
In this research, the fusion of several hydrophobic elements into a polymer-degrading biocatalyst is being studied. Different constructs consisting of a hydrophobin (class II hydrophobins from T. reesei and a mutant class I hydrophobin from G. frondosa) or a small hydrophobic peptide connected to the biocatalyst were constructed via molecular cloning and produced in E. coli. For the analysis of the fusion protein – polymer interaction, either commercially available polymer samples were used or thin films were prepared via spin-coating. The assembly on the hydrophobic polymer surface and the efficiency of the polymer-degrading biocatalyst is being analyzed via different surface analysis methods such as water contact angle measurement, surface plasmon resonance (SPR), attenuated total reflection Fourier transform infrared spectroscopy (ATR-FTIR), x-ray photoelectron spectroscopy (XPS) and atomic force microscopy (AFM).

FIGURES

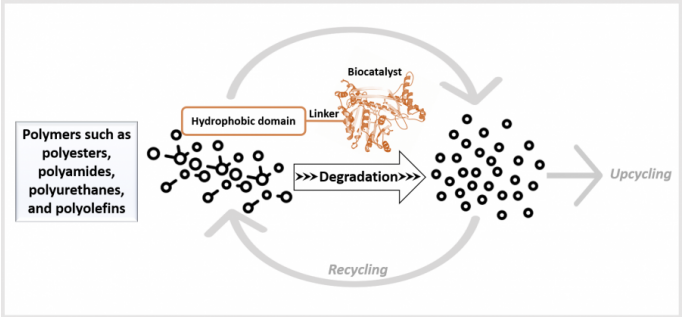

FIGURE 1

Schematic representation of the research topic

A hydrophobic domain (hydrophobin or a small peptide consisting of hydrophobic amino acids) is linked to a polymer-degrading biocatalyst.

FIGURE 2

KEYWORDS

polymer degradation | hydrophobin | fusion protein | surface analysis

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