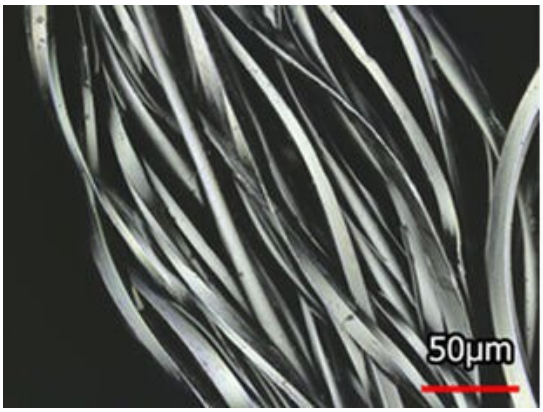

Projektträger Jülich
Forschungszentrum Jülich

Ministerium für
Kultur und Wissenschaft
des Landes Nordrhein-Westfalen

Development of expression systems of polyesterases for the sustainable modification and degradation of textile polyester

The textile market currently produces 60 million tons of new polyester fibers per year. In addition to all its advantages, polyester also has some disadvantages. For example, it has to be hydrophilized to make it comfortable to wear. For this purpose, the fibers are usually alkalized with alkaline solutions, which lead to effects such as pronounced pitting and thus reduced fiber stability, or coatings that can be abraded by mechanical stress are used. The issue of microplastics is also currently coming to the fore. In addition to the disposal of plastic waste in the oceans, the abrasion of microplastics from textiles is also causing more and more problems.

To counteract these problems, research in the field of polyester-functionalizing enzymes and polyester-degrading enzymes has increased significantly in recent years. Enzymes (so-called polyesterases) that can degrade amorphous polyester films are now commercially available. When treating polyester, the use of polyesterases results in a splitting of the ester groups to hydroxyl and carboxyl groups on the surface. This leads to slight surface hydrophilization and, in extreme cases, to complete polymer degradation. However, the enzymatic treatment of crystalline polyester fibers in textiles still poses a problem today.

The aim of the research project is to contribute to the development of sustainable, enzyme-based finishing of polyester textile surfaces. Suitable polyesterases (PETases, MHETases, cutinases etc.) are produced and optimized for this purpose. In addition to bacterial expression hosts (Escherichia coli and Bacillus subtilis), fungal expression systems (e.g. Aspergillus oryzae and Pichia pastoris) are used for enzyme production. In contrast to bacterial host systems, fungal expression systems have many advantages, such as a post-translational modification system and a high secretion capacity. By selecting suitable strains and optimizing the cultivation conditions, the expression of the enzymes is to be increased and also made more economical.

In addition, the performance of the expressed enzymes is to be optimized. With the help of enzyme engineering, modifications (modeling and rational protein design) are carried out on the enzymes in order to specifically adapt and improve the properties of the enzymes (pH and thermostability, improved substrate specificity) for the functionalization of textile polyester and the degradation of microplastics. The addition of auxiliary substances, such as anionic or cationic surfactants, is also an interesting option due to a possible increase in the affinity of polyesterases to the textile surface.

The purified polyesterases are then used to develop processes for the functionalization of textile polyester surfaces, e.g. to prevent the pilling or greying of textiles or to increase the wearing comfort by optimizing moisture management. In the future, this should enable a more gentle, environmentally friendly and economical treatment of textile polyester in the textile industry.

Project partners

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Duration

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Contact

Prof. Dr.-Ing. Uta Bergstedt
Molecular Biotechnology Member ILOC Institute
- Raum: R 110
- Telefon: +49 (0)2151 822-4060
- uta.bergstedt(at)hs-niederrhein.de

Sprechstunde: nach Vereinbarung

Britta Hilgenberg, Dipl.-Biol.
- Raum: Z 218 (Gebäude Z, 2. OG)
- Telefon: +49 2161 186-6129
- Fax: +49 2161 186-6199
- britta.hilgenberg(at)hs-niederrhein.de

Contact

Dr. Sabrina Kolbe
- Raum: Z 105
- Telefon: +49 2161 186-6029
- sabrina.kolbe(at)hs-niederrhein.de

Prof. Dr.-Ing. habil. Maike Rabe
Head of Research Institute "FTB" Textile Finishing and Ecology
- Raum: Z 110
- Telefon: +49 2161 186-6110
- maike.rabe(at)hs-niederrhein.de