

# Damage induced morphology changes and its relation to mechanical properties of high performance ultra-high molecular weight polyethylene fibers

## MSc Assignment

### Introduction

Avient Protective Materials (APM) produces high-performance fibers via hot drawing of solution-spun ultra-high molecular weight polyethylene (UHMWPE) fibers, Dyneema®. This provides fibers with a strength even up to 4.5 GPa and a density lower than water, making it a very stiff, strong, and lightweight synthetic fiber. These characteristics make it suitable for a wide range of demanding applications, ranging from for example on one hand combining yarns in ropes to fix windmill platforms or cables for cranes to lift heavy cargo, to on the other hand usage of the fibers in composites to stop bullets with helmets or bulletproof vests and other ballistic applications.

In some of these applications, e.g. where abrasion can become significant, it is observed that extensive use can lead to loss of properties and changes in crystalline morphology: the fraction of orthorhombic crystals reduces, the fraction of monoclinic crystals increases, and the overall orientation seems to reduce. In some cases, similar phenomena are observed during processing of the fibers into the end-product.

To better understand what induces these changes and its consequence on properties, this assignment will investigate in more detail what the link is between these crystalline structures and the mechanical performance and how these transitions are introduced. This could help shaping guidelines for processing to reduce property loss or criteria for maintenance or replacement of products in service.

### Assignment

The graduation assignment will aim at understanding the relationship between damage, the resulting structure, and the mechanical properties for UHMWPE fibers.

The assignment encompasses the definition of the scope of the assignment, a literature study, experimental analysis (mechanical and morphological), and if the results allow also modelling. The work will be carried out at the labs of Twente University in close cooperation and supervision of APM. If desired, it is also possible to perform (part of) the assignment at the APM facilities in Geleen or Heerlen, The Netherlands.

## Contact Details

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## About Avient Protective Materials

Avient Protective Materials is a business group within Avient that produces high-performance fibers spun from ultra-high molecular weight polyethylene. The high strength and stiffness with low weight are proven valuable for a wide range of demanding applications, ranging from ropes or cables for mooring and cranes to composites to stop bullets with helmets or bulletproof vests and other ballistic applications.

To guide product and application development, a large variety of research activities are on-going within Dyneema®'s Innovation Department. This covers the entire spectrum including processing the material, the resulting fiber properties, and its performance in applications.

The Innovation department is located in Geleen, The Netherlands.