Project title: **„Wet-spinning of graphene oxide-modified fibres“**

Project leader: Prof.-Dr.-Ing. Dipl.-Wirt. Ing. Gunnar H. Seide

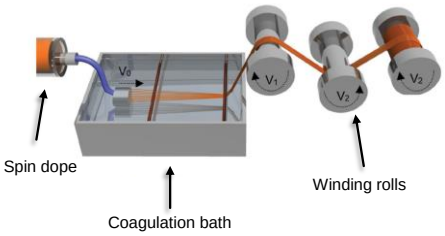
Function: Chair for Polymer Engineering - Aachen Maastricht Institute for Biobased Materials

Collaborators: RWTH Aachen University

Proposal (250 words):

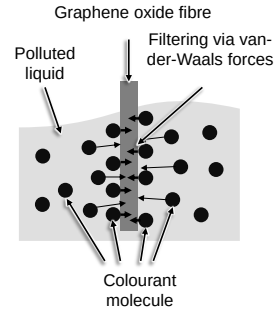
Introduction:

Graphene, the two-dimensional allotrope of carbon, offers potential for high-performance fibre materials due to its unique properties. For instance, publications of monofilament yarns produced by wet spinning are available indicating that graphene-based fibres exhibit electrical conductivities in the order of 10,000 S/m and mechanical properties in the order of 500 MPa and more. However, spinning process development of graphene is quite difficult as graphene does only rarely interact with surrounding matter in spinning solutions. The wet-spinning process is sketched in the figure below.



Hypothesis and Objectives:

As one consequence, graphene oxide came into the focus of interest as nematic-phase. Dopes with graphene oxide can be spun to fibres with a high degree of orientation of graphene oxide. Furthermore, fibres of graphene oxide can interact with surrounding matter due to van der Waals interactions caused by its hydroxyl and carboxyl groups. Recently, publications about nanocomposite fibres of graphene oxide and biopolymer materials have been made for potential applications as filter material for filtering of colourant pollution. The working principle is depicted in the figure below.



Setting and Methods:

The main goal of the proposed PhD project is the development of a pilot-scale wet-spinning process of graphene oxide in biopolymer matrix polymers. Therefore, several biopolymer materials like chitosan and cellulose are combined with graphene oxide specifications with varying aspect ratios. Suitable spinning solutions are developed and applications of graphene oxide fibres are evaluated.

Impact:

Biobased filters with unique effectivity from completely new material structure.

Maastricht University

Requirements candidate: Highly motivated student with good English communication skills and proactive and resolute attitude. Background in chemistry, polymer processing or physics needed.

Keywords: graphene, fibre, mechanical engineering, spinning, filter material, biobased material

Top 5 selected publications:

Nr.	Title	Authors	Journal
1	Orientation of well-dispersed multiwalled carbon nanotubes in melt-spun polymer fibers and ist impact on the formation of semicrystalline polymer structure : a combined wide-angle X-ray scattering and electron tomography study	Vad, T.; Wulfhorst, J.; Pan, T.-T.; Steinmann, W.; Dabringhaus, S.; Beckers, M.; Seide, G.; Gries, T.; Sager, W.F.C.; Heidelmann, M.; Weirich, T.E.	Macromolecules 46 (2013), H. 14, S. 5604-5613, doi: 10.2021/ma40001126
2	Extrusion of CNT-modified polymers with low viscosity : influence of crystallization and CNT orientation on the electrical properties	Steinmann, W.; Vad, T.; Weise, B.; Wulfhorst, J.; Seide, G.; Gries, T.; Heidelmann, M.; Weirich, T.	Polymers & Polymer Composites 21 (2013), H. 8, S. 473-482
3	Increasing washing performance of wet-spun fibers	Akdere, M.; Schriever, S.; Seide, G.; Gries, T.	International Journal of Clothing Science and Technology 28 (2016), H. 3, S. 293-299, doi: 10.1108/IJCST-03-2016-0034
4	Novel carbon nanotube/cellulose composite fibers as multifunctional materials	Qi, H.; Schulz, B.; Vad, T.; Liu, J.; Mäder, E.; Seide, G.; Gries, T.	ACS Applied Materials & Interfaces 7 (2015), H. 40, S. 22404–22412, doi 10.1021/acsami.5b06229
5	Extrusion of CNT-modified polymers with low viscosity : influence of crystallization and CNT orientation on the electrical properties	Steinmann, W.; Vad, T.; Weise, B.; Wulfhorst, J.; Seide, G.; Gries, T.; Heidelmann, M.; Weirich, T.	Polymers & Polymer Composites 21 (2013), H. 8, S. 473-482