Hochschule für Telekommunikation Leipzig

Institut für Textiltechnik und Lehrstuhl für Textilmaschinenbau

RWTH AACHEN UNIVERSITY

Project title: Prediction and Modelling of thermal and optical treatment's influence on the basis of structural properties of polymer optical fibres (POF)

Partner: Institut für Kommunikationstechnik (IKT), Hochschule für Telekommunikation, Leipzig (HfTL)

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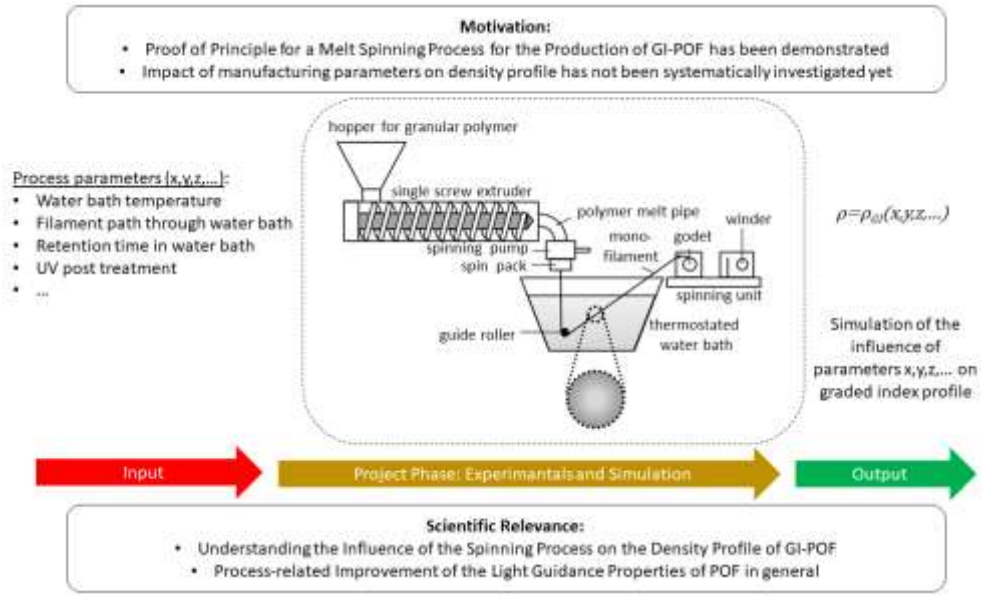
Mission Statement



Goals

A large number of patented processes already exist for the production of polymer optical fibres with graded index (GI-POF). A disadvantage of the previous processes is, however, the fact that these manufacturing processes are either discontinuous (drawing processes from predefined cylinders), take a considerable amount of time due to polymerization (gel polymerization and inline polymerization in the extrusion of POFs) or the production speed is limited (dry spinning process). In order to solve these problems, the project partners developed a continuous and scalable melt spinning process for the production of GI-POF. Although the fundamental suitability of the technology has been proven by the preliminary work carried out so far, considerable improvements must be achieved: on the one hand in the fibre attenuation and on the other hand in the more precise control of the refractive index profiles to be achieved in order to be able to use this new process in a targeted and controlled manner and to be competitive with existing processes. This

requires a better understanding of the formation process of the molecular structure of the optical polymer during filament formation.

The goals of the research project are therefore:

- Influence and interaction of thermal and optical treatment steps on structure formation of optical polymers
- Knowledge transferred to melt spinning process for GI-POF
- Reduce damping losses in continuously produced GI-POFs

Approach

The project will be structured into an experimental and a simulative/analysing part.

In the experimental part, polymer optical fibres are produced from polymethylmethacrylate (PMMA) using the melt spinning process developed at the Institute of Textile Technology. The production and treatment parameters (e.g. water bath temperature, filament path in the water bath, winding speed, post-treatment with UV radiation, etc.) are adjusted selectively within the framework of a DOE method. The resulting filaments are analysed with regard to their structural and optical properties. Based on the experimental values, a phenomenological model is developed to determine the optical properties of the GI-POF. Based on this, a molecular structure model will be developed, which maps the temperature-dependent structure formation, especially in the range of the glass transition temperature. This enables the simulative design of the melt spinning process with regard to the density profile of the GI-POF.

Such a functional model offers the possibility to transfer the spinning process for the production of GI-POF, which has been developed within the scope of previous work, to other optical polymers. Furthermore, a precise, i.e. quantitatively explored, understanding of the structure formation could further reduce the attenuation of optical polymer fibres, which among other things leads to higher data transmission and longer ranges in telecommunication applications.

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