Project title: New Drug release systems from frozen fume fibres

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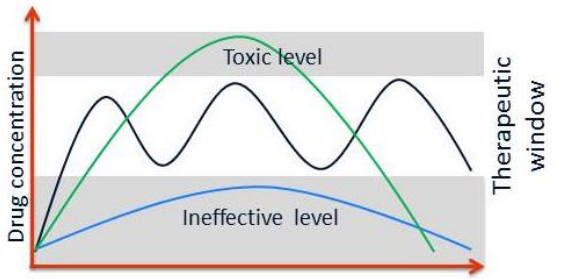
Collaborators: RWTH Aachen University, German Aerospace Center (DLR)

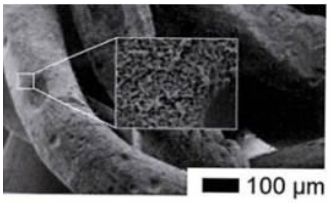
Proposal (250 words):

Introduction:

Drug release systems are used in medical application to release drugs in a needed concentration. Too fast release leads to toxic concentration, too slow release to ineffective concentration. Aerogels, also known as frozen fumes or solid air, are the least dense solids yet discovered due to their highly porous structure. We have carried out unique preliminary trials showing that the production of aerogel fibres is possible.



Drug release, influenced by pore structure



Porous aerogel fibres

Hypothesis and Objectives:

- Aerogel fibres could serve as drug release systems as they consist mainly of pores which could be filled.
- Aerogel fibres can be spun from biocompatible polymers.
- How can the drug release be influenced by pore size, pore size distribution and molecular orientation?
- Which polymers do perform best?
- Which process is needed to achieve the necessary structure?

Setting and Methods:

• Production of cellulose-based aerogel fibres according to the known manufacturing process
• Modelling the relationships of fibre structure and process parameters (spinning dope preparation, spinning, drying)
• Production of chitosan-based aerogel fibres
• Modelling the relationship of fibre structure and process parameters
• Testing of the fibres as a drug release system
• Production of aerogel fibres from mixtures of chitosan and cellulose
• Modelling the relationship of fibre structure and process parameters

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- Testing of the fibres as a drug release system
- Technical and economic evaluation of the produced aerogel fibres

Impact:
Aerogel could solve the problem of too fast or too slow release of drug (therapeutically concentration not reached or exceeded) by pore structure design of biocompatible fibre structures.

Requirements candidate: Highly motivated student with good English communication skills and proactive and resolute attitude, chemistry or polymer processing background

Keywords: Fibre, biobased, aerogel, process-simulation, polymer, textile

Top 5 selected publications:

1. Björn Schulz, Tobias Meinert, David Bierbüsse, Michel Busen, Nina Körtzinger, Michael Stankowski, Gunnar Seide: Cellulose Aerogel Fibers Tested on a REXUS 18 Rocket - The ACTOR Project; Chemie Ingenieur Technik, Bandnummer:88 , Ausgabe:10 ,pages 1501-1507; Wiley , 2016 ISSN: 0009-286X

2. Qi, H.; Schulz, B.; Vad, T.; Liu, J.; Mäder, E.; Seide, G.; Gries, T.: Novel carbon nanotube/cellulose composite fibers as multifunctional materials ACS Applied Materials & Interfaces 7 (2015), H. 40, S. 22404–22412, doi 10.1021/acsami.5b06229

3. Akdere, M.; Schriever, S.; Seide, G.; Gries, T.: Increasing washing performance of wet-spun fibers; International Journal of Clothing Science and Technology 28 (2016), H. 3, S. 293-299, doi: 10.1108/IJCST-03-2016-0034

4. Mroszczok, J.; Beyerlein, G.-S.; Frenzer, G.; Kasper, S.; Gries, T.; Seide, G.: Cellulose aerogel fibres for thermal encapsulation of diesel hybrid engines for fuel savings in cars In: ISASF International Society for the Advancement of Supercritical Fluids (Ed.): Proceedings / 3rd International Seminar on Aerogels : Synthesis, Properties, Applications, 22 - 23 September 2016, Sophia Antipolis (France). - Paris : MINES ParisTech ; PS

5. Köhler, T.; Lüking, A.; Pico, D.; Seide, G.; Gries, T.: Aerogels: lightest solid in the world; In: Simoncic, Barbara; Tomšic, Birgita; Gorjanc, Marija (Eds.): 16th World Textile Conference AUTEX 2016, 8–10 June 2016, Ljubljana, Slovenia. - Ljubljana : Faculty of Natural Sciences and Engineering, Department of Textiles, Graphic Arts and Design, 2016