Project title:

Research on isocyanate and phosgene free synthesis of biodegradable collagen-inspired poly(ester urethanes) containing amino acids as bioactive component and its mechanism in promoting the regeneration of abdominal wall defect

Project leader: Associate Professor dr. Katrien V. Bernaerts, Aachen-Maastricht Institute for Biobased Materials, Maastricht University, the Netherlands (katrien.bernaerts@maastrichtuniversity.nl)

Function: Associate Professor Sustainable Polymer Synthesis

Collaborators: Prof. dr. Tianzhu Zhang, School of Biological Science and Medical Engineering, Southeast University, Sipailou 2, Nanjing 210096, China (zhangtianzhu@seu.edu.cn)

Proposal (250 words):

Introduction:
In tissue engineering, e.g. repair of abdominal wall defects, ideal regeneration efficiency cannot always be obtained by using both biodegradable synthetic polymer and biological-derived materials such as decellularized extracellular matrix (ECM). The crucial reason is that there is still lack of deep understanding of the relation between the function and structure of the used materials.

Hypothesis and Objectives:
Collagen has always been used to promote the regeneration of tissue, however, the reasons why the collagen can work effectively are not clear. We speculate that the type and sequence of amino acids in collagen can promote the growth of cells as well as the fibrous structure of collagen. Herein, biodegradable amino acid or tripeptide-based poly(ester urethanes) (PEU) will be designed and synthesized in order to mimick the structure of collagen fiber as closely as possible. The PEU will be further electrospun into a film and used to evaluate its biocompatibility, efficacy in promoting the growth of fibroblasts and consequent regeneration of abdominal wall. The underneath PEU structure-function relationship will be disclosed.

Setting and Methods:
At Maastricht University: PEU monomers and polymers will be synthesized via innovative routes free of traditionally used toxic isocyanates or (tri)phosgenes.
At Southeast University: use fibroblast to evaluate the biocompatibility of the synthesized PEU, such as viability, proliferation and migration, if time allows regeneration efficacy of abdominal wall defect in SD rat model.

Impact:
This research will provide beneficial insights into the design and construction of high-performance biomaterials for repair of abdominal wall defect.
With our new approach towards PEU free of toxic isocyanates and (tri)phosgenes, we can make a positive impact on environment and health.

Requirements candidate: Highly motivated student with good English communication skills and proactive and resolute attitude. The student should have skills in organic and polymer synthesis/characterization, as well as biomedical skills related to tissue regeneration and cell studies.

Keywords:

Collagen-inspired; amino acid containing polymer; biodegradable; poly(ester urea); abdominal wall regeneration

Maastricht University

Top 5 selected publications, with citation scores:

1. Zhou, N.; Ma, X.; **Bernaerts, K.V.**; Ren, P.; Hu, W.; **Zhang, T.**, Expansion of ovarian cancer stem-like cells in poly(ethylene glycol)-crosslinked poly(methyl vinyl ether-alt-maleic acid) and alginate double-network hydrogels, ACS Biomaterials Science & Engineering 2020; 6(6), 3310-3326, https://doi.org/10.1021/acsbiomaterials.9b01967 [IF 5.13]

2. Hu, W.; Lu, S.; Zhang, Z.; Zhu, L.; Wen, Y.; **Zhang, T.**; Ji, Z.. Mussel-inspired copolymer grafted polypropylene mesh with anti- adhesion efficiency for abdominal wall defect repair, Biomaterials Science, 2019, 7, 1323–1334. DOI: 10.1039/c8bm01198b [IF 6.183]

3. Ansari, V.; Calore, A.; Zonderland, J.; Harings, J. A. W.; Moroni, L.; **Bernaerts, K. V.**, Additive Manufacturing of alpha-Amino Acid Based Poly(ester amide)s for Biomedical Applications. Biomacromolecules 2022, 23 (3), 1083-1100. [IF 6.988]

4. André X., **Bernaerts Katrien V.**, Hyperbranched polymeric polyurethane dispersants and non-aqueous pigment dispersions, PCT/EP2010/063145, Agfa, 2009.

5. Coenen, A.M.J.; **Bernaerts, K.V.**; Harings, J.; Jockenhoevel, S.; Ghazanfari, S., Elastic materials for tissue engineering applications: natural, synthetic, and hybrid polymers, Acta Biomaterialia 2018; 79, 60-82, https://doi.org/10.1016/j.actbio.2018.08.027 [IF 8.947]