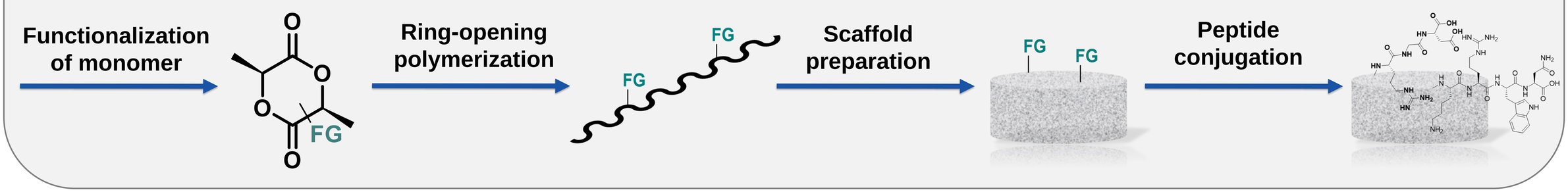
Designing cell-material interactions by controlling the chemistry of the surface of degradable porous scaffolds

Tove Kivijärvi†, Daniela Pappalardo†,‡, Anna Finne-Wistrand†

† Department of Fibre and Polymer Technology, KTH Royal Institute of Technology, Teknikringen 56-58, 100 44 Stockholm, Sweden

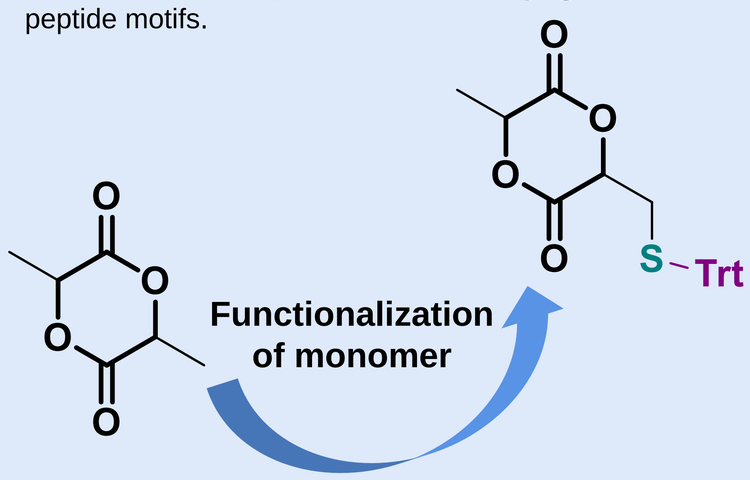
‡Department of Science and Technology, University of Sannio, via dei Mulini 59/A, 82100 Benevento, Italy

PrintKnit The overall aim of this research project is to design and develop porous, degradable polymeric scaffolds for soft tissue regeneration using 3D-printing. Developing a material with precise control over the architecture, bioactivity and degradation rate requires integration of the structural, mechanical and chemical environment. In these settings, one direction in PrintKnit is the development of functional polymers with surface modifications allowing for interactions with cells and surrounding tissue.



Monomer synthesis

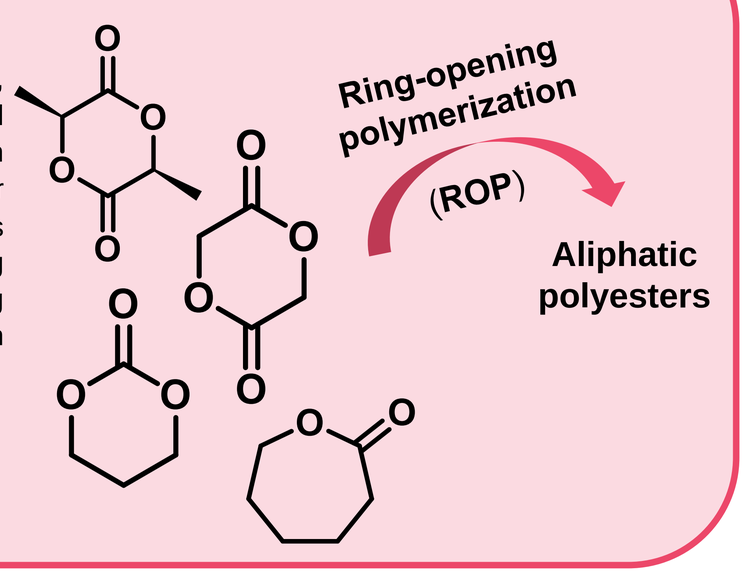
Previously, our group has developed a lactide-based monomer with a pendant thiol moiety which was copolymerized with ε-caprolactone and L-lactide.[1] The side functionality was conjugated to an RGD-peptide via disulphide-linkage, showing **cell compatibility**. In current state, we are evaluating the conjugation of peptide based monomeric units with aliphatic organic polymers in more detail. In parallel, we are developing functionalized lactide-based monomers allowing for simple **conjugation** to peptide motifs.



[1] T. Fuoco; A. Finne-Wistrand; D. Pappalardo *Biomacromolecules* **2016**, *17*, 1383.

Polymerization

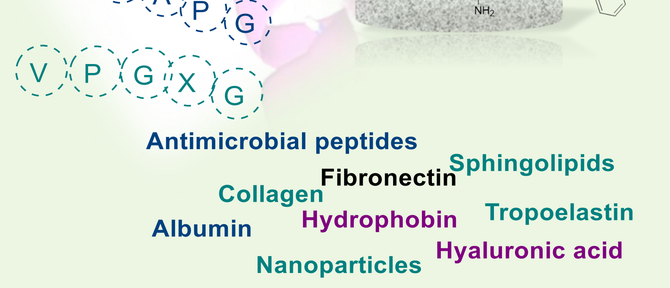
Aliphatic polyesters, such as poly(lactide), poly(glycolide), poly(trimethylene carbonate), as well as poly(caprolactone) and their copolymers have been used in the field of tissue engineering due to their mechanical and **degradable** properties as well as biocompatibility.[2] Our group is using ring-opening polymerization, as it offers the advantage of fine-tuning the reaction conditions to produce copolymers with controlled molecular weight and microstructure.

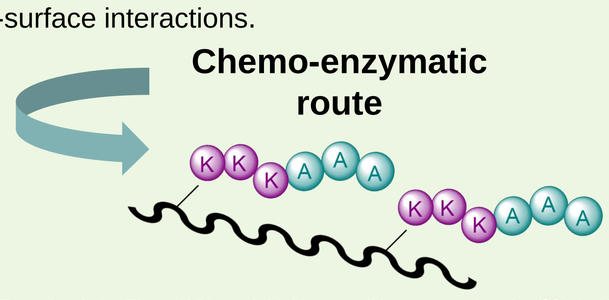


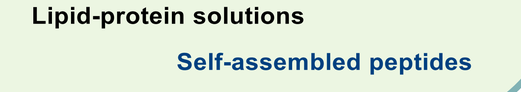
[2] R. P. Brannigan; A. Dove *Biomater. Sci.* **2017**, *5*, 9.

Chemical modification

Untreated aliphatic polyesters often have an hydrophobic and non-functionalized surface, which yields limitations in terms of cell adhesion or un-wanted absorption in the biological environment. Engineering well-defined **peptide/polymer structures** can be used to circumvent these drawbacks. Previously, our group has explored amphiphilic co-oligopeptides using lysine and alanine for biomedical applications prepared via chemo-enzymatic routes.[3] Currently, we are developing routes for using peptide ligation techniques to covalently conjugate bioactive motifs with simple functional handles of the polymer backbone to increase cell-surface interactions.







[3] J. Fagerland; A. Finne-Wistrand; K. Numata *Biomacromolecules* **2014**, *15*, 735.

Swedish Foundation for Strategic Research

This work was financially supported by the Swedish Foundation for Strategic Research (RMA15-0010).

PRINTKNIT

Tove Kivijärvi
Ph.D. Student

Phone: +46(0)737-772 819
E-mail: toveki@kth.se

KTH Royal Institute of Technology
Department of Fibre and Polymer Technology

Teknikringen 56-58
SE-100 44 Stockholm
SWEDEN