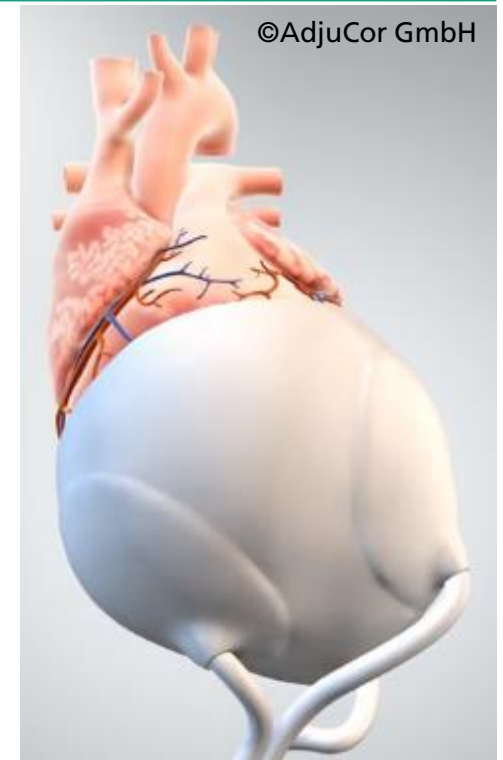


# Synthesis, Characterization and Processing of Novel Polymer Materials for Biomimetic Implants

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# Aims of the PolyKARD Project

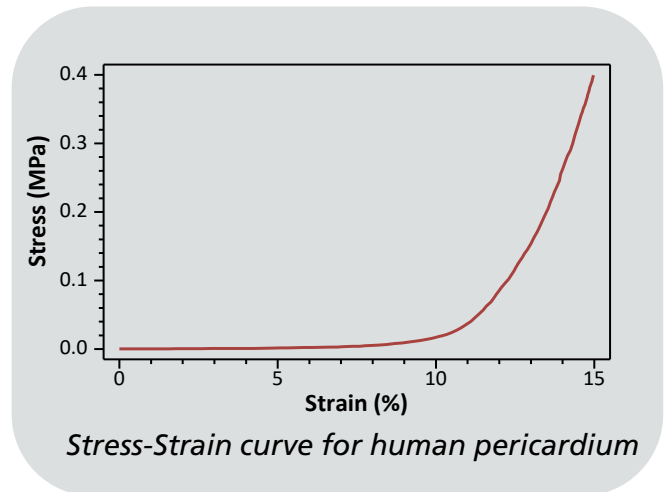
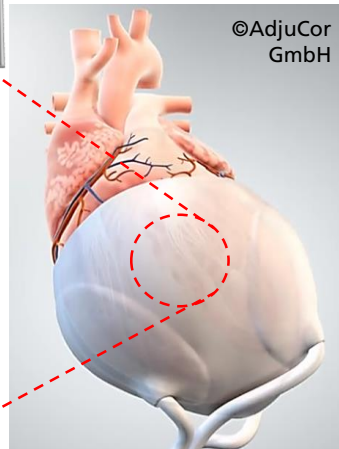
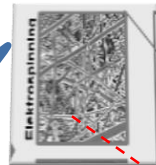
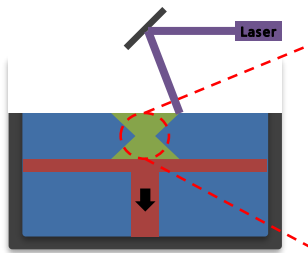
- Developing novel flexible polymers with mechanical properties corresponding to natural pericardium as a support system for the heart

## 2. Electrospinning fiber fabrication

2. High molecular weighted and soluble polymers

## 1. 3D Printing for CAD based structuring

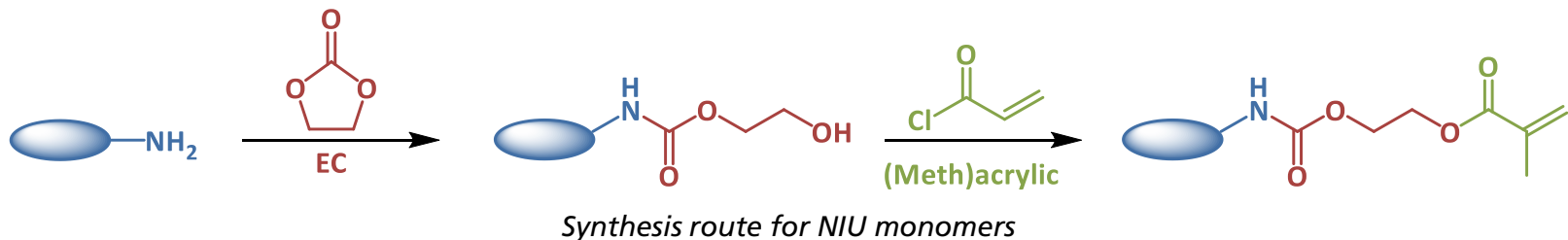
Small molecules & photocurable (resins)



# NIU Monomers

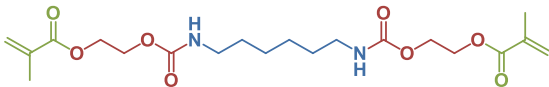
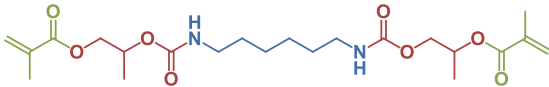
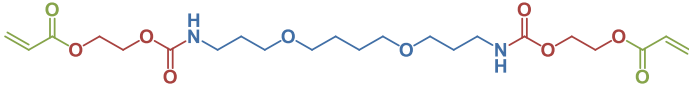
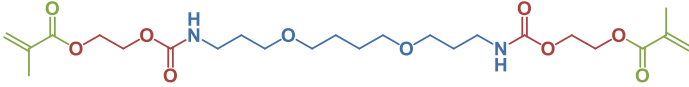
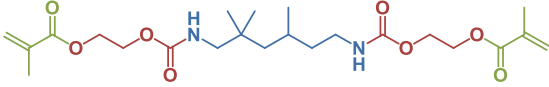
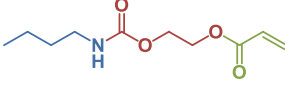
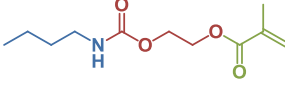
for photo curable resins as *reactive diluent* and *crosslinker*

- A library of photo-active urethane-acrylate monomers was developed through NUI chemistry. Amine and diamine compounds were converted to hydroxylureathanes through the reaction with ethylene carbonate. Later, the hydroxyl groups of the hydroxylureathanes are converted to the (meth)acrylates through reaction with (meth)acryloyl chloride.



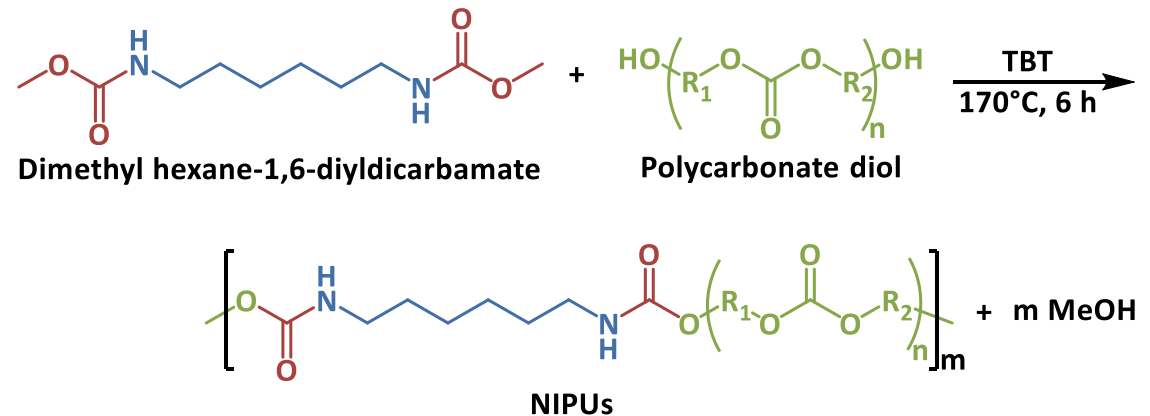
# NIU Monomers

crosslinkers & reactive diluents

Name	Chemical Structure	Meting Point	Cured Sample
UrDMA1		76 °C	hard
UrDMA2		–	less flexible
UrDA1		31 °C	less flexible
UrDMA3		43 °C	flexible
UrDMA4		–	hard
UrA1		2 °C	very flexible
UrMA1		3 °C	hard

# Non-Isocyanate Polyurethanes (NIPUs)

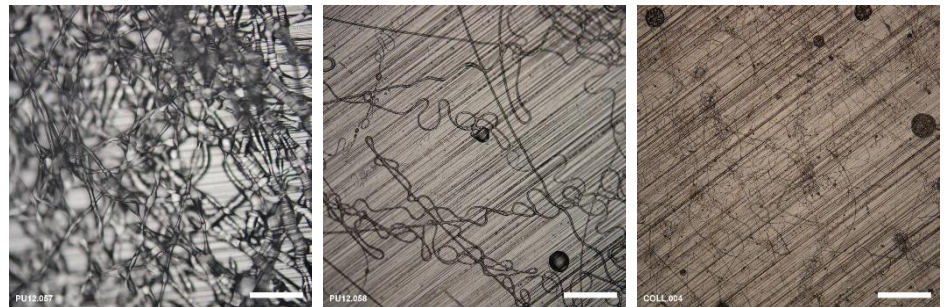
- High-molecular non-isocyanate polyurethanes (NIPUs) were prepared through transurethanization reaction of dimethyl hexane-1,6-diyl dicarbamate and polycarbonate diols.
- The prepared NIPUs have molecular weights in the range of 14.000-26.000 g/mol and melting points of 44-108 °C.



*Synthesis route for NIPUs*

# Electrospinning

- Utilizing electrospinning, polymer solutions are processed into porous, fibrous carrier substrates.
- Polymers were spun using different solvents, which in turn thoroughly influence the microstructure of fibers.



*Electrospun polymers analysed under a light microscope. From left-to-right: NIPU spun out of 40% THF, NIPU spun out of 27% HFIP, and collagen spun out of an 8% PBS/ethanol mixture. Scale bar: 200  $\mu$ m.*

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# Outlook & Thanks

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- Synthesis of high molecular weight NIPUs for more elastic high-performance materials
- SEM imaging of electrospun scaffolds to assess fiber size and porosity
- Functionalization of collagen to develop reactive fibrous hybrid systems based on combination of NIPUs and collagen.
- Please visit our project page:
  - <https://promatleben.de/de/projekte/projekte-alphabetisch/polykard/>
- **Thanks for BMBF for funding and you for listening !**
- Contact: wolfdietrich.meyer@iap.fraunhofer.de