PROGRAMME DE COOPÉRATION TRANSFRONTALIÈRE
GRENSOVERSCHRIJDEND
SAMENWERKINGSPROGRAMMA

Interreg
France-Wallonie-Vlaanderen

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Elasto-Plast

New biobased TPEs developped during the ELASTOPLAST project

Adrian Gainar, Wim Thielemans (**KULAK**)

Stijn Corneillie (**Centexbel**)

Julien Cayuela (**Materia Nova**)

Robert Mundil, Franck Kayser, Julie Meimoun, Audrey Favrelle, Grégory Stoclet, Philippe Zinck (**ULille**)

Cofinancie
ring

met de steun van west-vlaanderen de gedreven provincie

Wallonie

AGENTSCHAP INNOVEREN & ONDERNEMEN

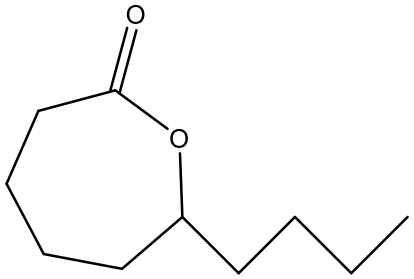
AVEC LE SOUTIEN DU FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL
MET STEUN VAN HET EUROPEES FONDS VOOR REGIONALE ONTWIKKELING

Why biobased TPE ?

- Use of renewable feedstock - Depletion of fossil resources
- Consumers pressure
- New / alternative building blocks provide new structures

Building Blocks for Biobased Synthetic Elastomers

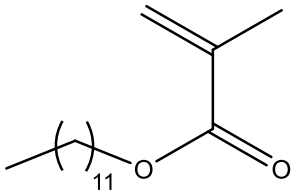
- **Oilseed biomass based monomers**
  - Cyclic ester



ε-decalactone

Castor oil

- Long chain (meth)acrylate

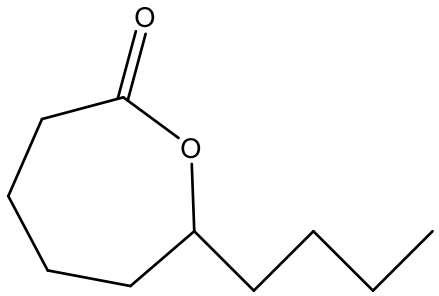


Lauryl methacrylate

Lauryl alcohol from
Palm kernel oil
Coconut oil

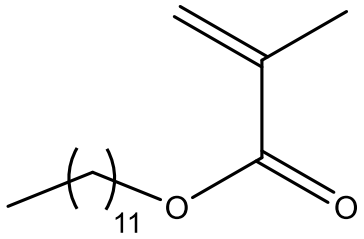
New biobased TPE's : Background and strategy

- **Implementation**
  - Using commercial biobased monomers



ε-decalactone

T_g PDL -60°C



Lauryl methacrylate

T_g PLMA -55°C

- **PMMA as the hard block**

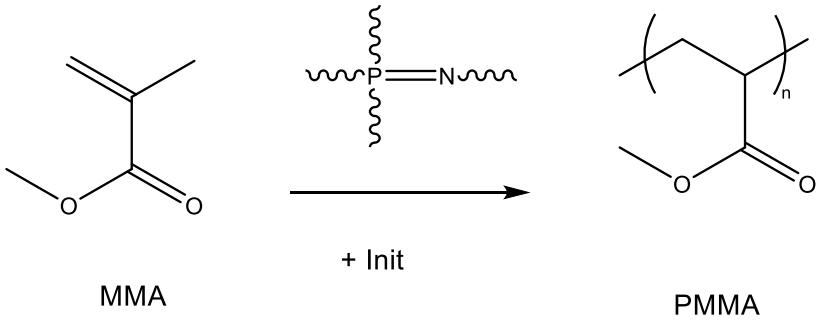
  - Reasonnably high T_g around 110°C
  - Immiscible with PDL and PLMA (checked)

→ Higher temperature of use than *e.g* SBS (partial miscibility)

  - Feasibility in terms of chemistry
  - One pot approach : block copolymerization

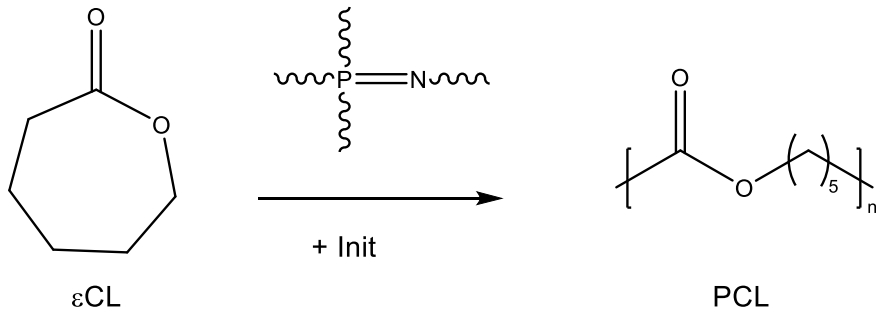
New decalactone based TPE

- **Organocatalysis : an old tool brought up to date**
  - Phosphazene bases as catalyst for PMMA synthesis



Seebach et al.
Angew. Chem. 1993 **32** 716

- Recent progress : also for lactones

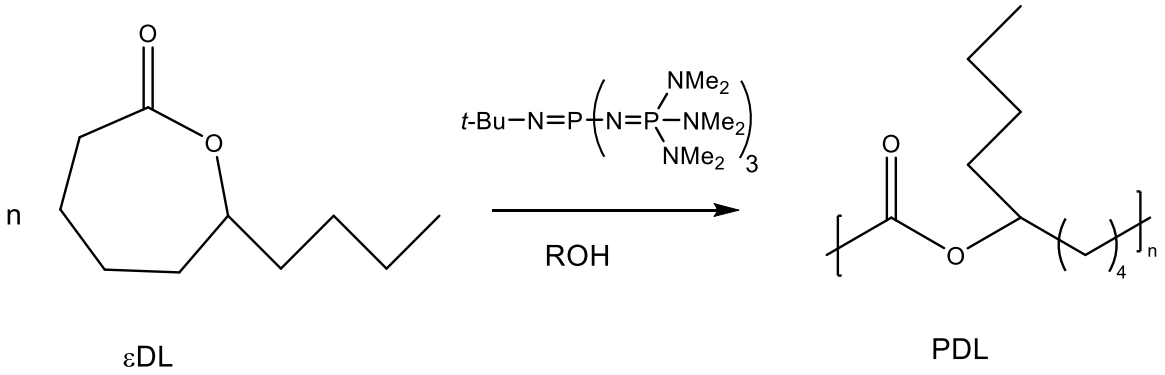


Hadjichristidis et al.
Polym. Chem. 2014 **5** 5471

- **Our idea : Use this chemistry with the biobased decalactone to make block copolymer with PMMA**

New decalactone based TPE

- First step : can phospazenes polymerize DL ?



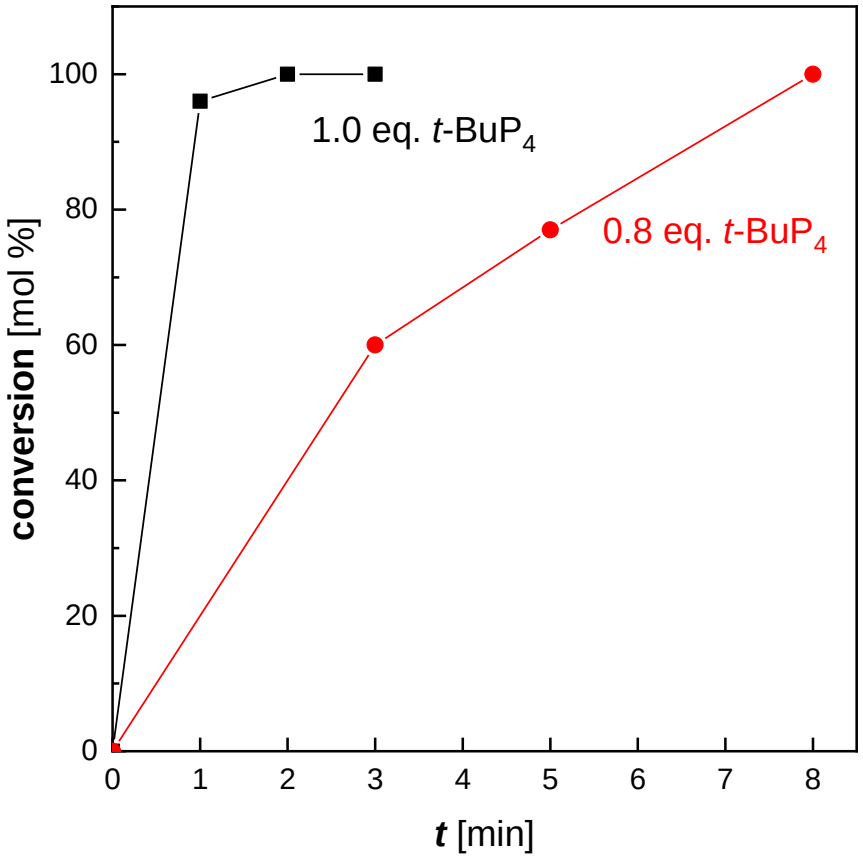
εDL	ROH	P=N Catalyst	Conversion (%)	Mn SEC g/mol	Đ	Mn calc. g/mol
100	1	0.2	2	nd	nd	-
100	1	0.4	35	8 300	1.26	6 000
100	1	0.6	65	11 300	1.31	11 100
100	1	0.8	100	14 400	1.39	17 000
100	1	1	100	12 200	1.54	17 000

1h reaction
THF
25°C

- Yes they can !

New decalactone based TPE

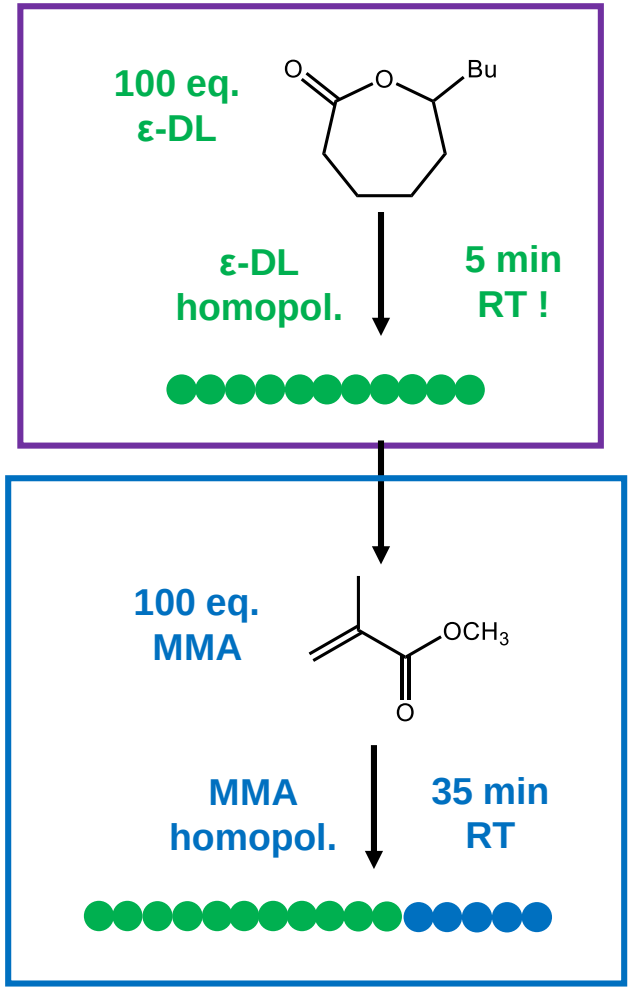
- Optimization
- Kinetic study

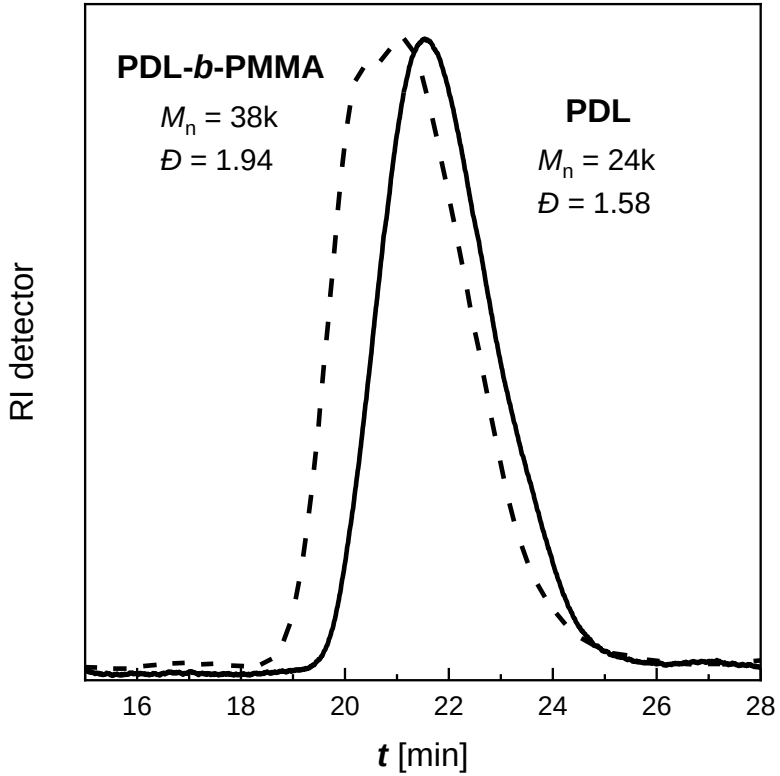


- Very fast reaction : less than 5 min at room temperature

New decalactone based TPE

- Second step : can we block copolymerize DL with MMA ?



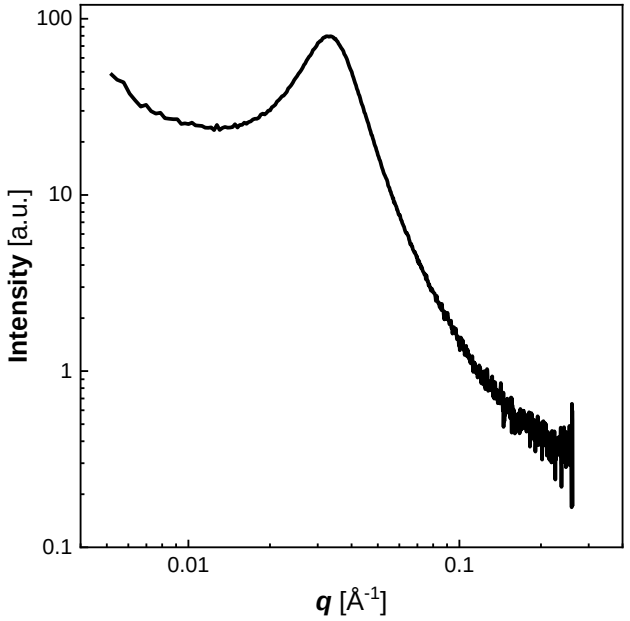


ε-decalactone content : 66 wt%

- Yes we can !
- Full conversion for both steps

New decalactone based TPE

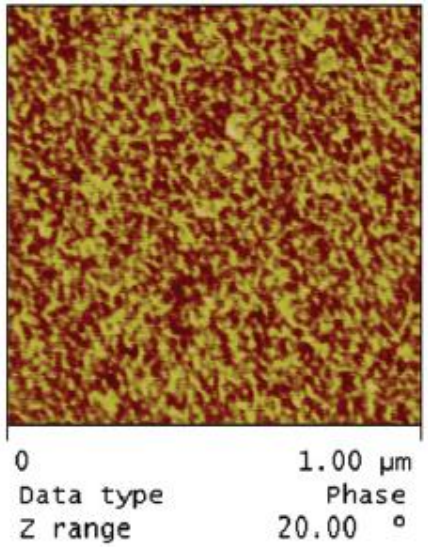
SAXS analysis
(Small Angle X-Ray)



Nanostructuration is clearly confirmed

New decalactone based TPE

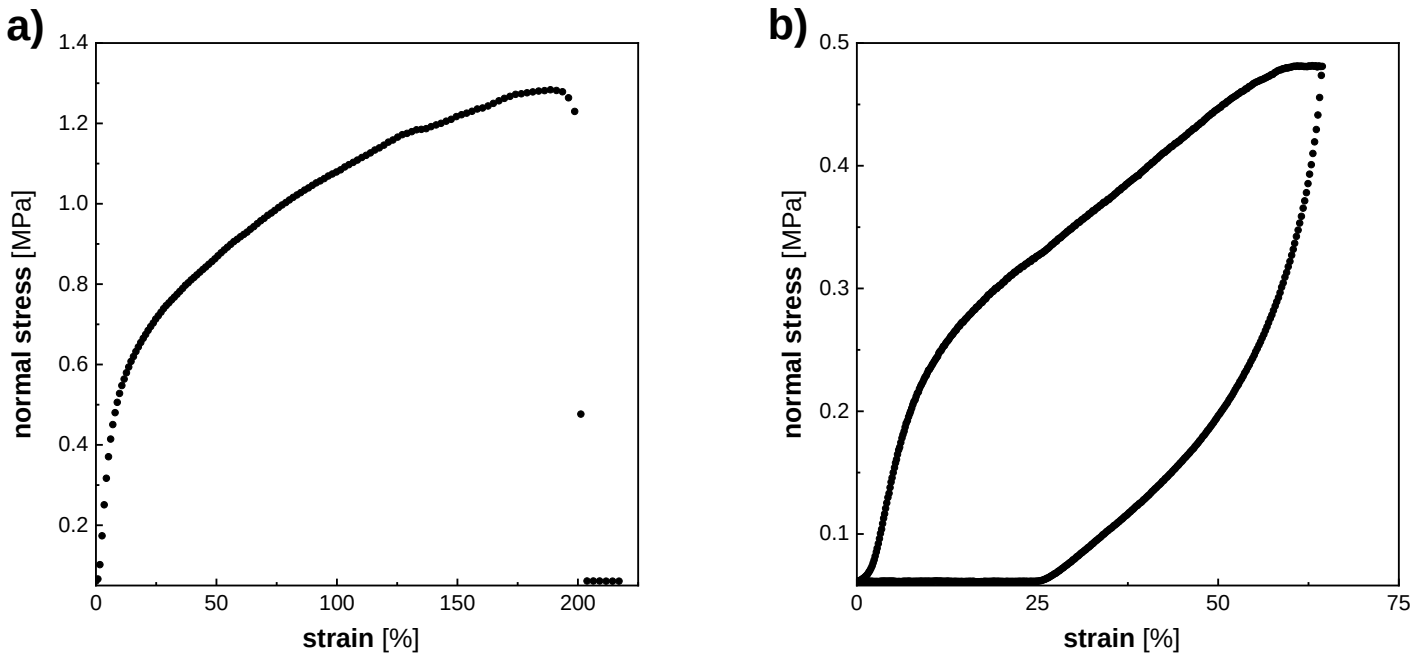
AFM analysis
(Atomic Force Microscopy)



Separation of 2 phases

New decalactone based TPE

Mechanical tests



tensile testing

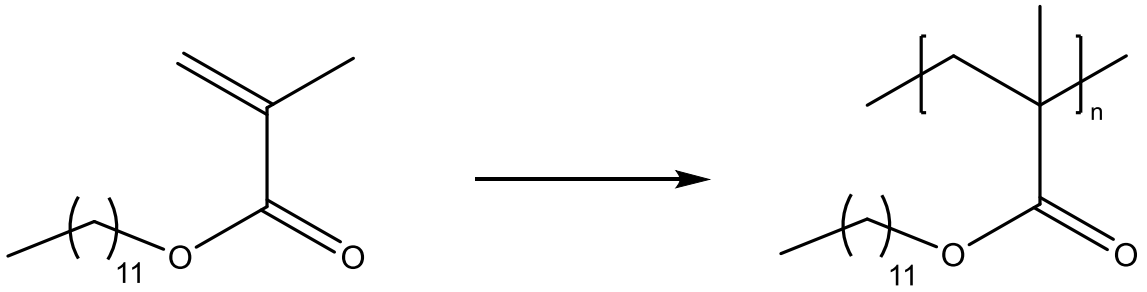
tensile modulus 8.5 MPa
strain at break 200%

recovery experiment

recovery ratio of 50%

- Work published in *Chem. Com.* **2020**, 56, 8067
  Manuscript available online :
  https://interreg-elastoplast.eu/sites/default/files/2021-01/Publicatie_ULille_2020_3.pdf

New lauryl methacrylate based TPE
Background and strategy



PLMA – Poly(lauryl methacrylate)

Tg -55°C

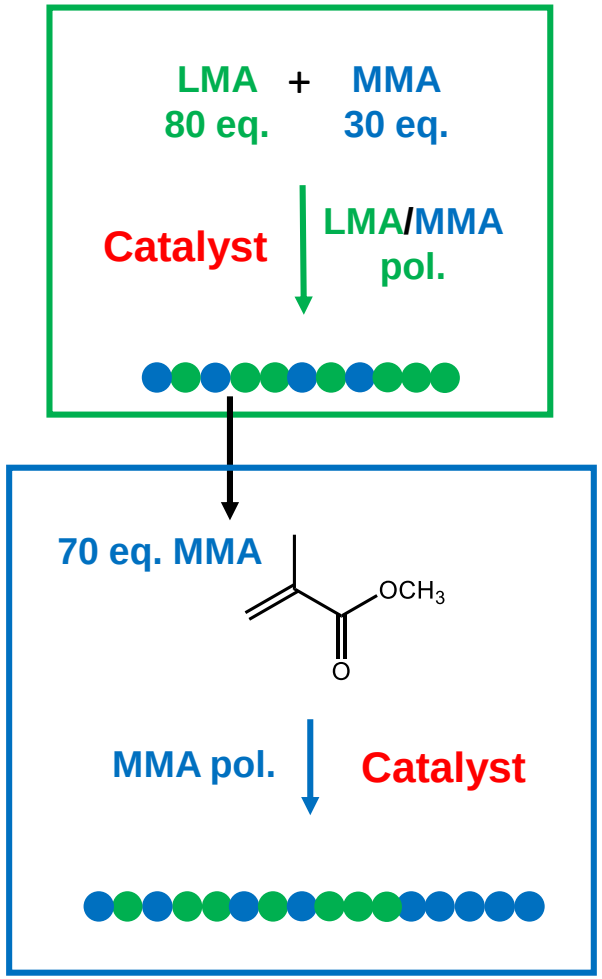
- PMMA – PLMA – PMMA TPEs shows a very low elongation at break, range 10-100%

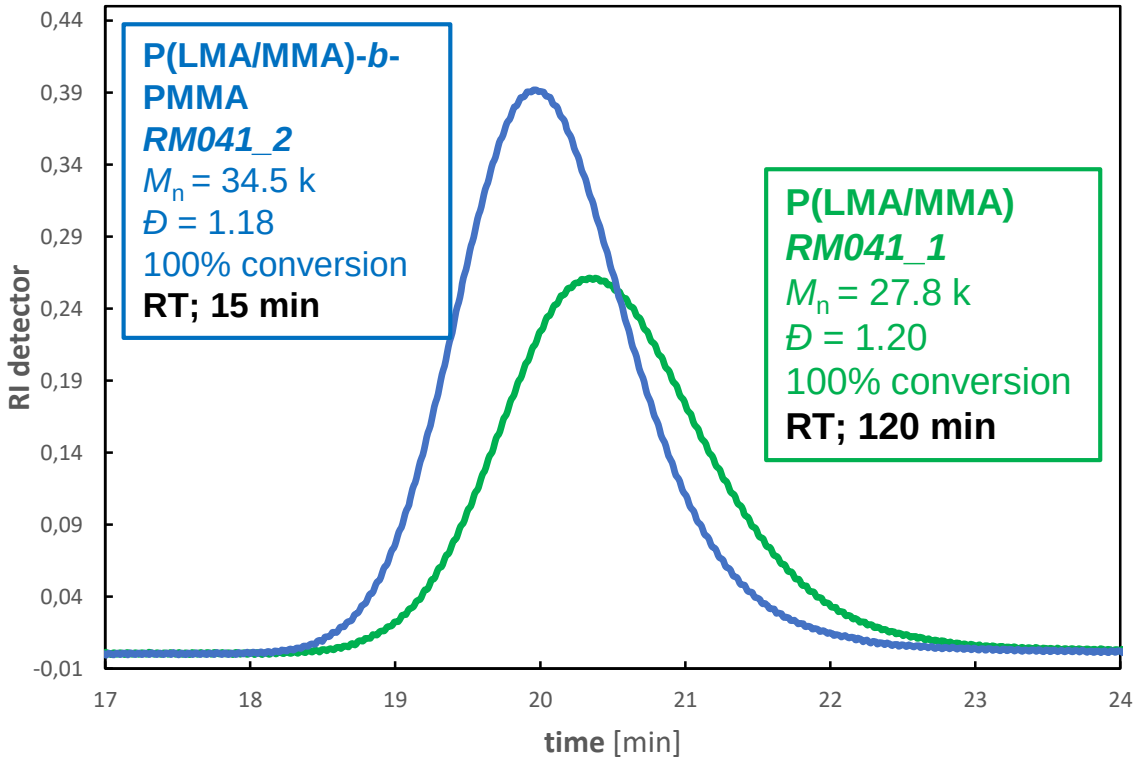
➡ Attributed to strain-induced crystallization (Mandal et al., *Macromolecules*, 2006, **39**, 91920)

- Our idea to improve :

➡ to insert a low fraction of MMA in the soft PLMA block to hamper cristallisation

New lauryl methacrylate based TPE

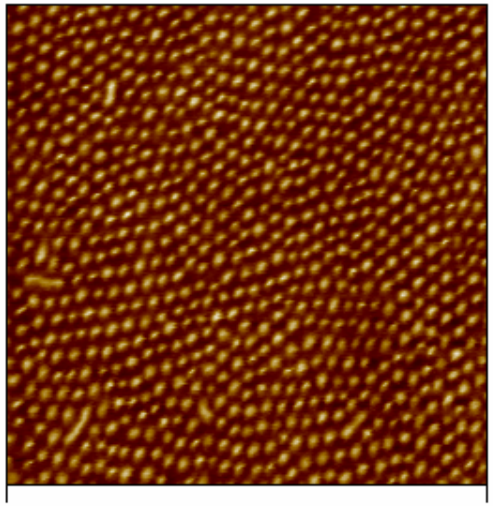


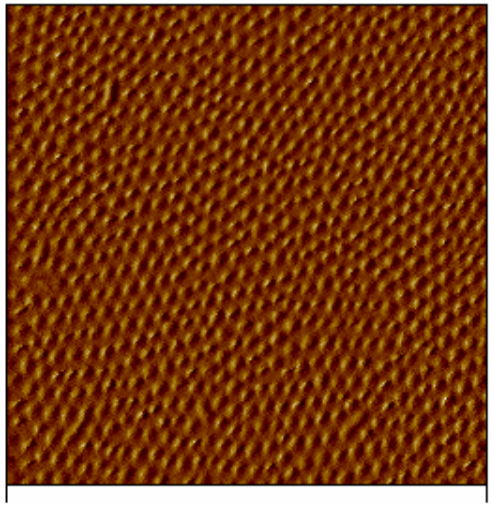


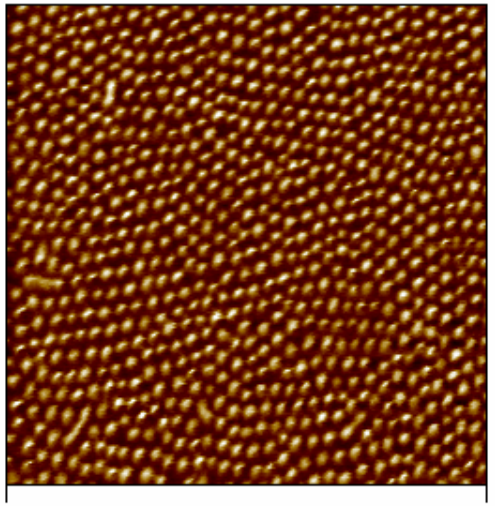
Lauryl methacrylate content : 75 wt%

New lauryl methacrylate based TPE

AFM analysis

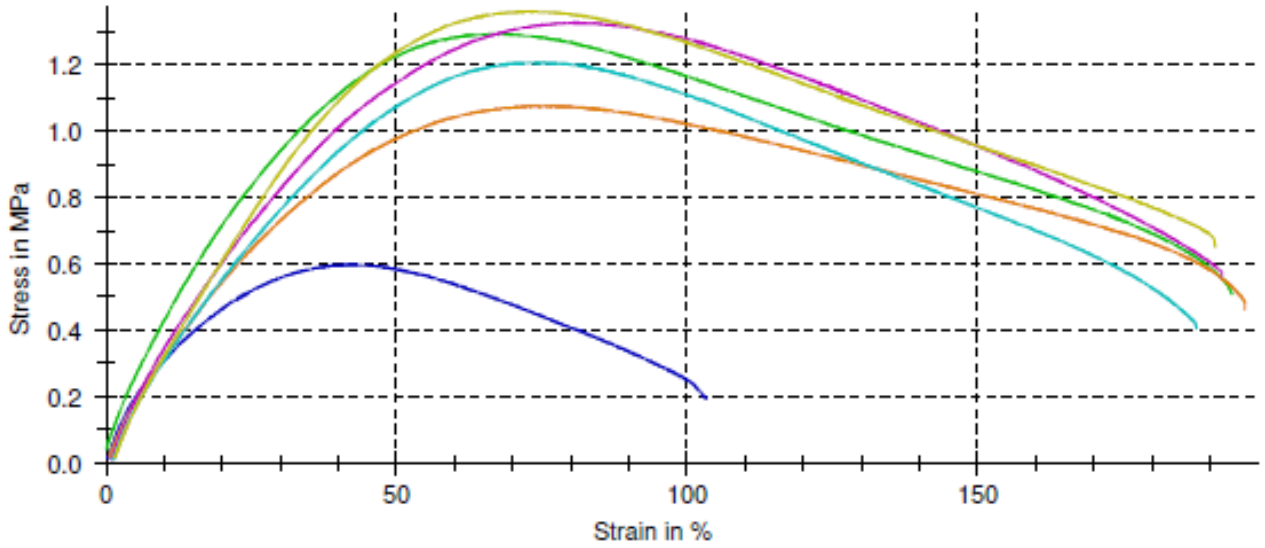






New lauryl methacrylate based TPE

Tensile tests

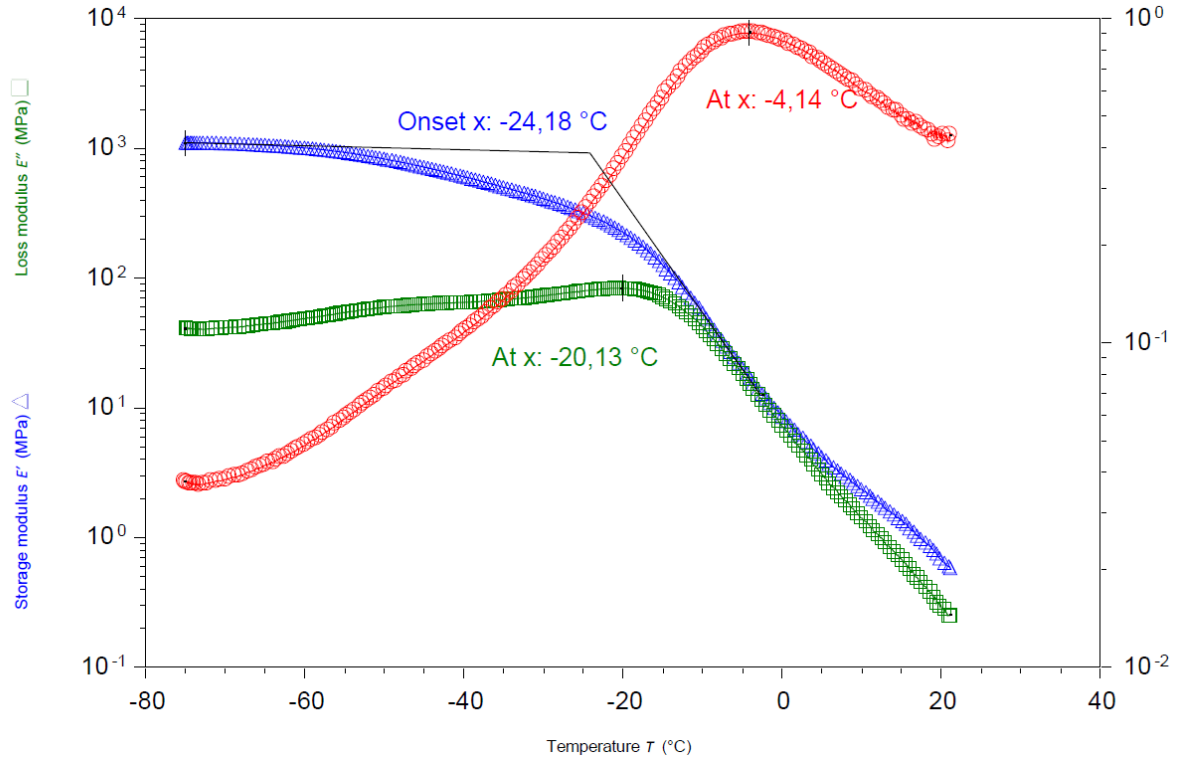


- Elongation at break > TPE with pure PLMA as the soft block (literature)
- Concept of hampering the cristallisation validated ?

- WAXS Analyses to be done

New lauryl methacrylate based TPE

DMA
Dynamical mechanical analyses



- Good damping properties
- High tackiness : Potential applications for patch, PMMA adhesion

Thank you for your attention !

Projectleider

Chef de file

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