

Synthesis and dynamics of model supramolecular polymer networks

Clément Coutouly

Supervisors:

Prof. Charles-André Fustin
Prof. Evelyne Van Ruymbeke

- Born in **Albi** (South of France, near Toulouse), October 27th 1992



- 2 years in **Classes Préparatoires** aux Grandes Ecoles in Lycée Lapérouse, Albi

- 1 year in Engineering School at **ENSCBP** in Bordeaux

- Chemistry License** at Bordeaux University in 2015

- Internship (2 months) at **IECB** (*European Institute of Chemistry and Biology*)
Peptidomimetic Chemistry Lab (Pr. Gilles Guichard)
Supervisor: **Dr. Morgane Paseo**

Synthesis of 1,2-diamines diversely substituted, road to oligureas Foldamers



- Master's degree** in Chimie Moléculaire et Macromoléculaire at Bordeaux University (2015-2017):



- Internship (6 months) at **LCPO** (*Laboratoire de Chimie des Polymères Organiques*)

TEAM: Polymerization Catalysis and Engineering (Pr. Daniel Taton)

Supervisors: **Pr. Daniel Taton** and **Pr. Stéphane Carlotti**

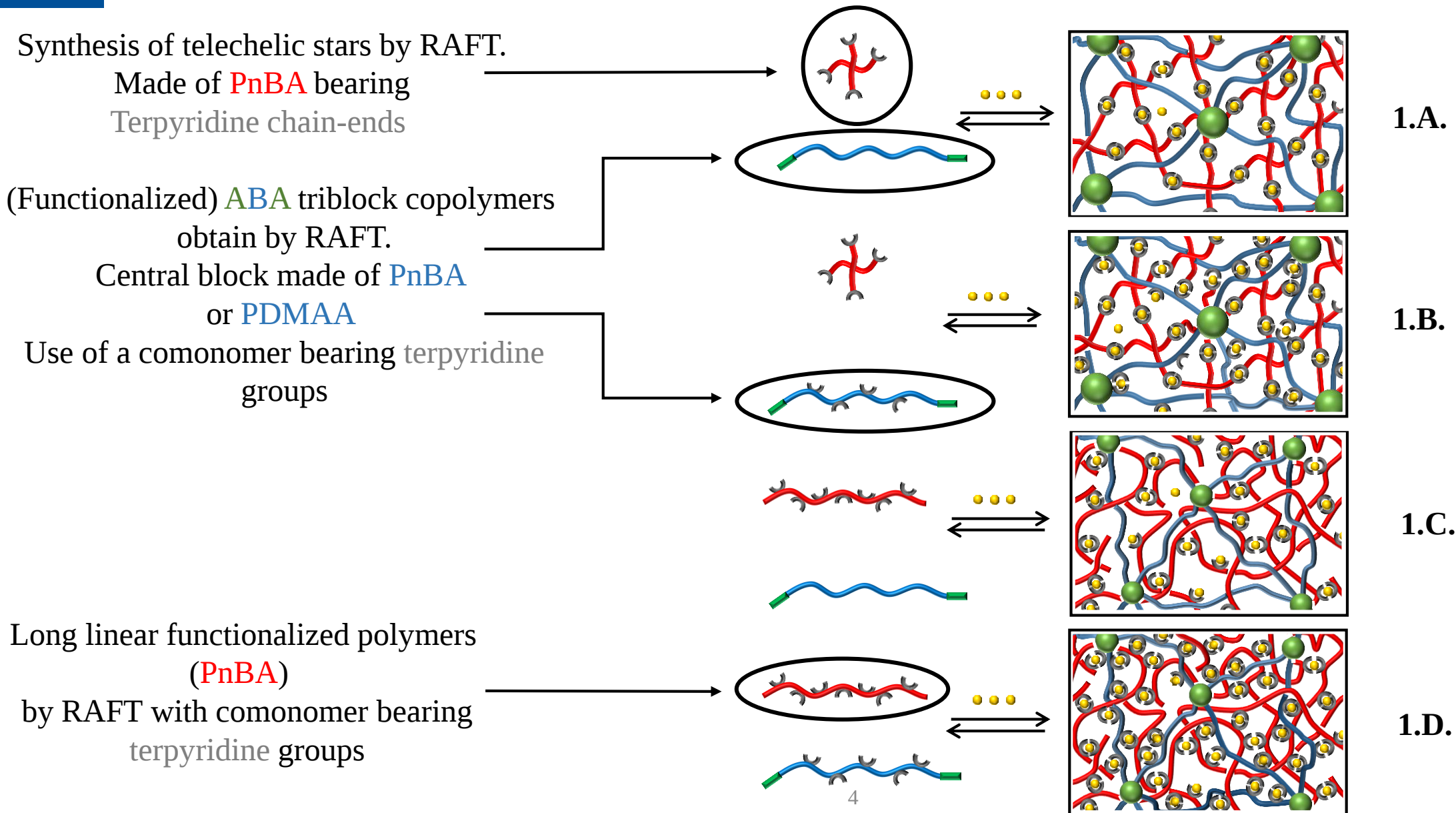
n-Heterocyclic carbene organocatalyzed ring-opening polymerization of activated aziridine



Research Objective:

Design new soft functional materials with improved properties based on the central concept of double dynamics

- **Easy to process:** Avoid permanent bond
- **Resist flow and creep:** Phase separation will be studied promoting reversible chain association under specific conditions
- **Dissipate energy to resist fracture:** Presence of supramolecular junctions like metal-ligand bond
Variation of the molecular structure of the building blocks
- **Large equilibrium:** Dense supramolecular network needed (large bond concentration)
➡ Phase separation for example
- **Double network properties in melt and in solution:** Select different systems by changing their concentration

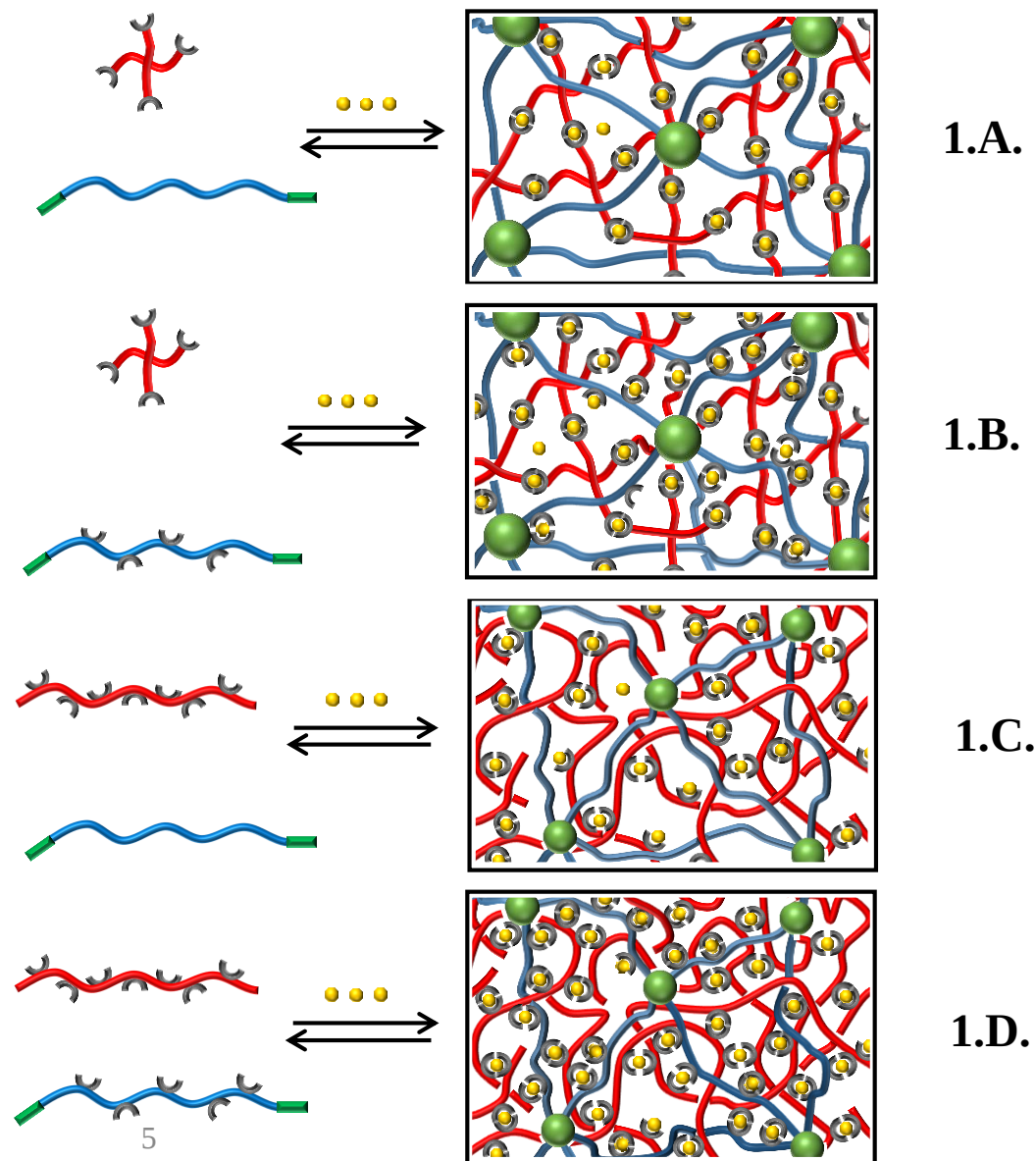


Characterization of the DDNs: LVE and NLVE

- Provide the response to large deformation
- Assess the material response during processing
- Understand the exact role of crucial structural and external parameters of DDNs

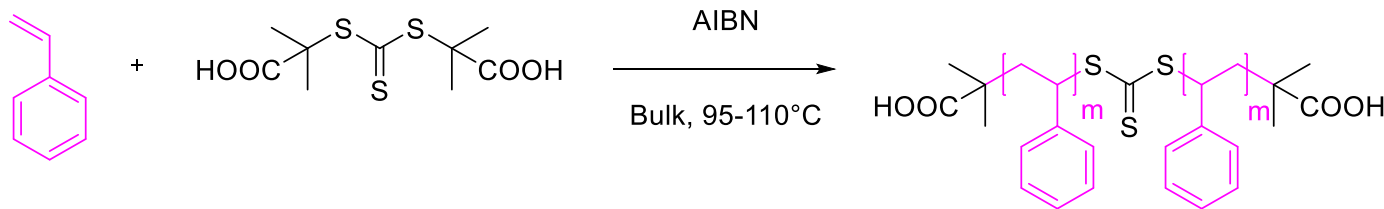
LVE : Linear Viscoelastic region

NLVE : Non Linear Viscoelastic region



RAFT POLYMERIZATION of ABA Triblocks

- Synthesis route to PS-*b*-PS (Hard outer blocks)

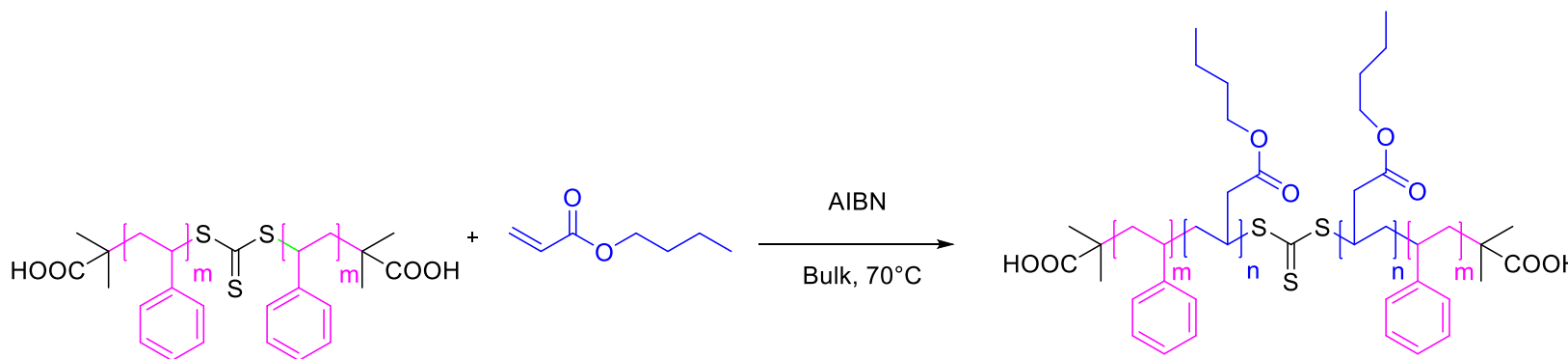


- ✓ Conversion 35-45 % ^a (depend on the length wanted)
- ✓ Fast kinetics (~ 3-4 h)
- ✓ $M_n = 2400-3600-6200 \text{ g.mol}^{-1}$ ^b



Formation of a Macro RAFT Agent

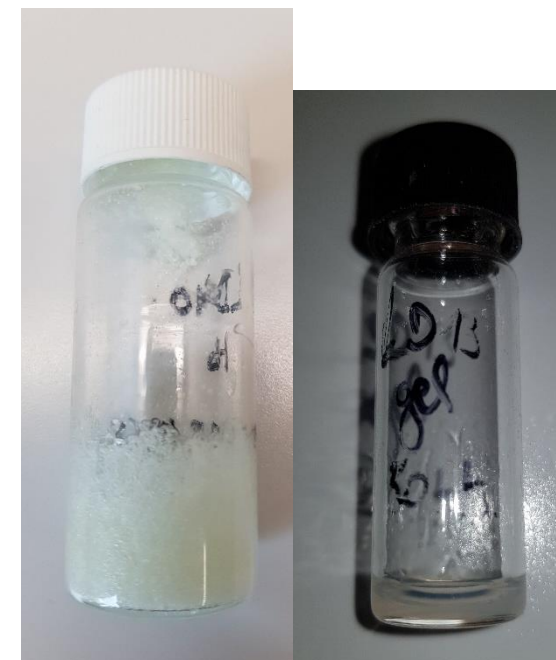
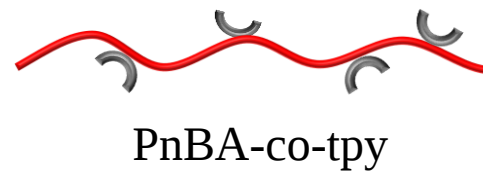
- Block copolymer PS-*b*-PnBA-*b*-PS (With PnBA as soft central block)



- ✓ Conversion ~70 % ^a
- ✓ $M_n = \sim 110\,000 \text{ g.mol}^{-1}$ ^b

a: determined by ^1H NMR in CDCl_3

b: determined by GPC in DMF with PS-calibration



- Workshop in every DoDyNet meetings (FORTH meeting, DSM meeting, DTU meeting)
- Summer School in Capri (DoDyNet Meeting at the end of July)
- Rheology lectures in UCL (Prof Evelyne Van Ruymbeke, LMECA2141)
- Belgian Polymer Group conference (May 2018, May 2019)
- PhD Day at UCL in Louvain-la-Neuve (May 2018, May 2019)

Poster presentation in :

- DoDyNet Meeting in Capri, end of July
- Belgian Polymer Group conference (May 2019)
- PhD Day at UCL Louvain-la-Neuve (May 2019)

Secondments:

- 4 weeks in Allnex (Brussels) under the supervision of Dr. Patrice Roose (Septembre 2019 – March 2020)
- FORTH University under the supervision of Prof. Dimitris Vlassopoulos



Expectations with regard to their future career as MSCA fellows:

- Acquire technical skills to my project by learning new analysis techniques
- Get experience in different fields (Polymer Chemistry, Rheology...) and extend my research network
- Collaborate with the most outstanding experts
- Get professional maturity thanks to secondment opportunities
- Collaborate with other MSCA Fellows around Europe from very different fields

Thank you for your
attention

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