Nano-engineering of aqueous polymer latex particles for film formation applications using multiblock copolymers

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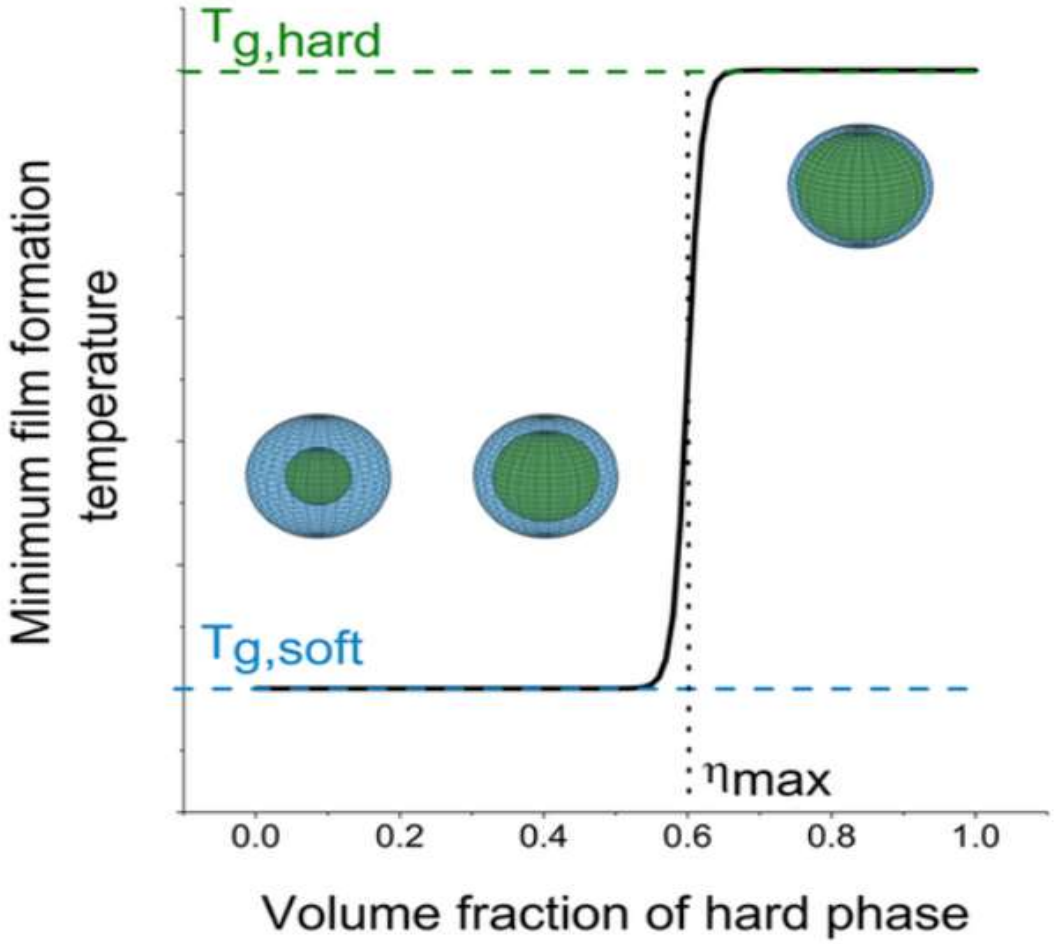
Background: Multiblock copolymer latex particle film formation



MFFT

Hard core T_g <60 wt%< Soft shell T_g

Aguirre *et al*. M. Polymer Colloids: Current Challenges, Emerging Applications, and New Developments. *Macromolecules* **2023,** *56* (7), 2579-2607.
Brito, E.L. and N. Ballard, Film formation of hard-core/soft-shell latex particles. *Journal of Polymer Science*, **2023.** 61(5): p. 410-421.

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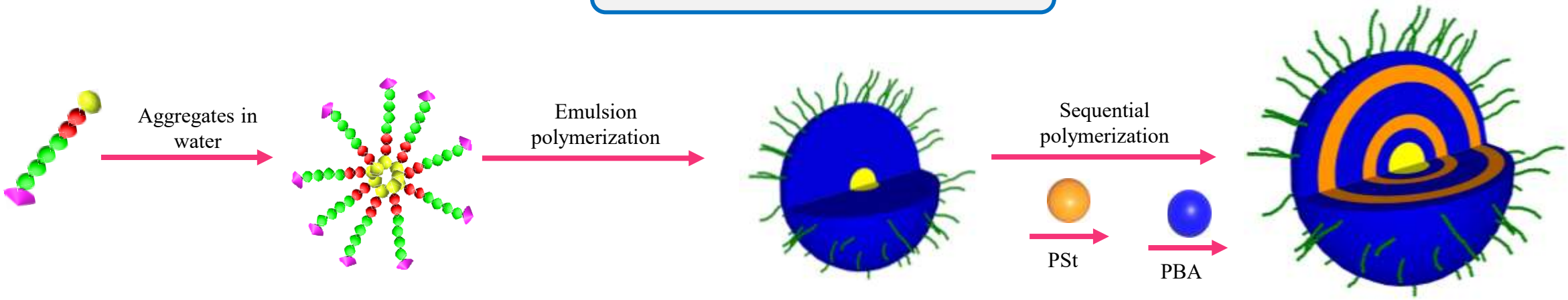
Background: Multiblock copolymer synthesis via RAFT polymerization

RAFT emulsion polymerization



ADVANTAGES
<< Compartmentalization >>

- High degree of livingness
- Fast polymerization rate
- Applicable to low *k*p monomers
- Environmentally friendly (water as media)

APPLICATIONS

- Nanomedicine
- Materials science
- Latexes films
- Many more

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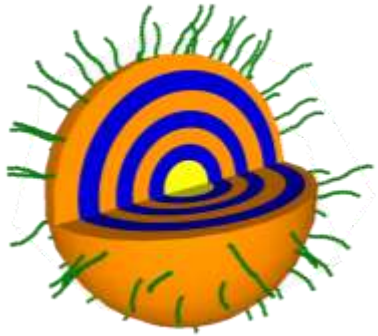
Multiblock copolymer films and mechanical properties

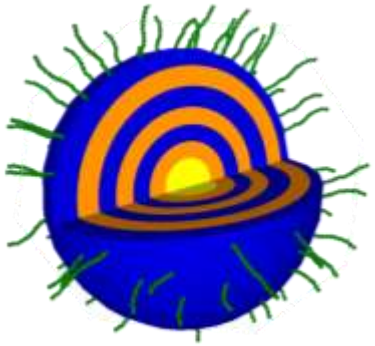
PBA seed latex

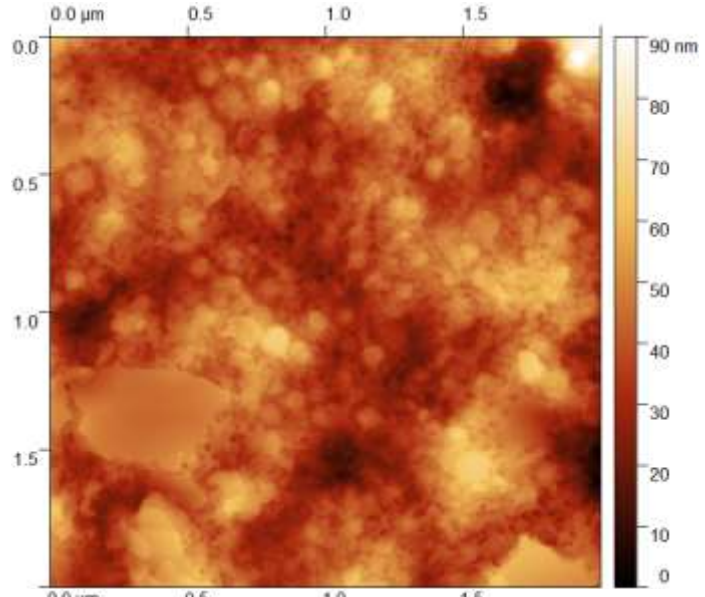


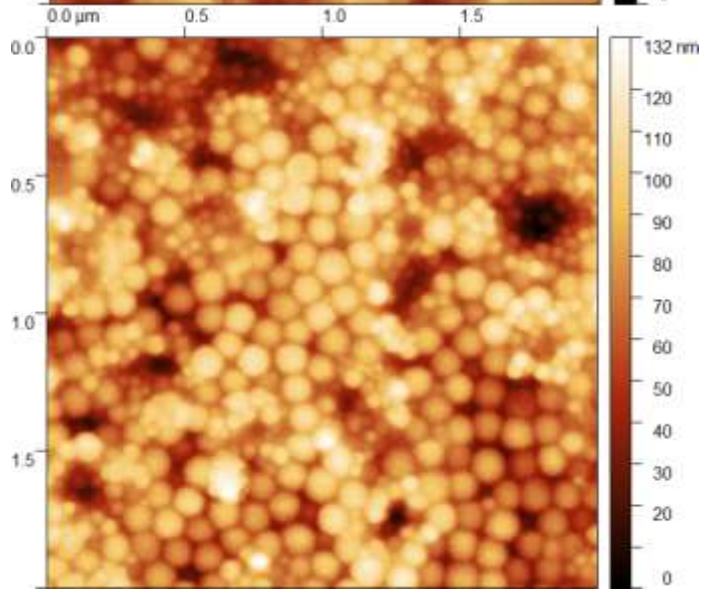
PSt

PBA

PS seed latex

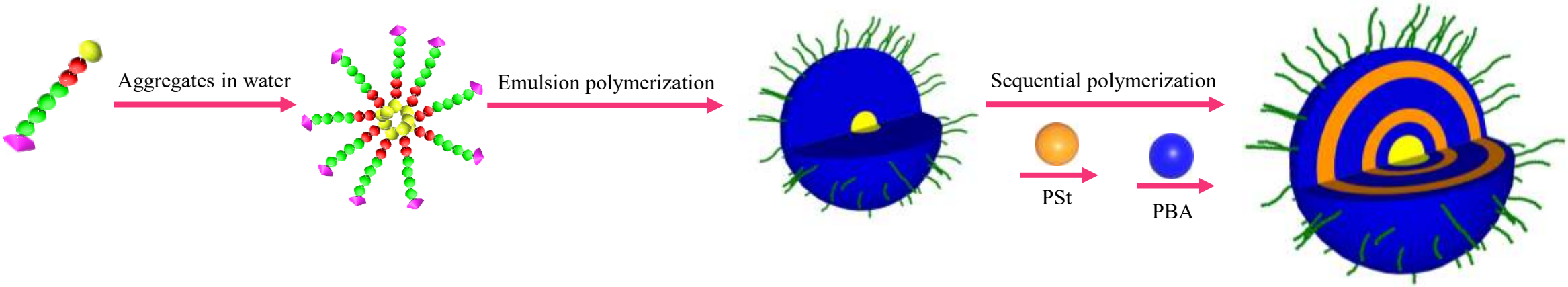


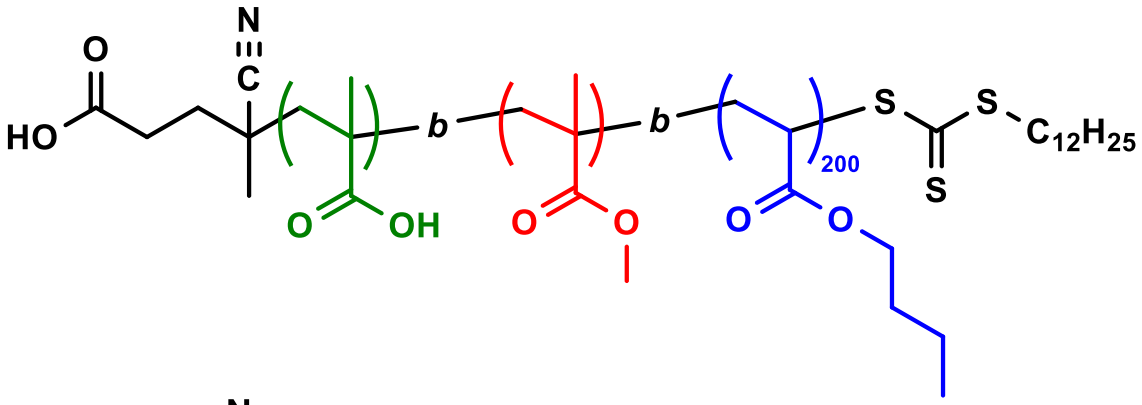


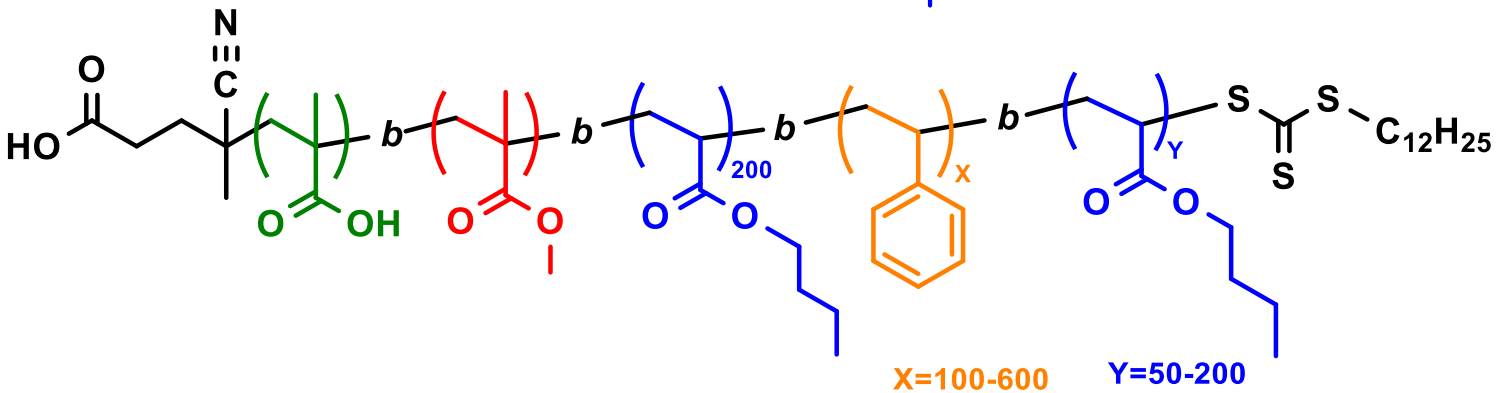


Thompson S.W. *et al*. *Macromolecules*, **2023**. 56(23): p. 9711-9724.

Nanoreactor concept: Multiblock copolymers by RAFT emulsion polymerization



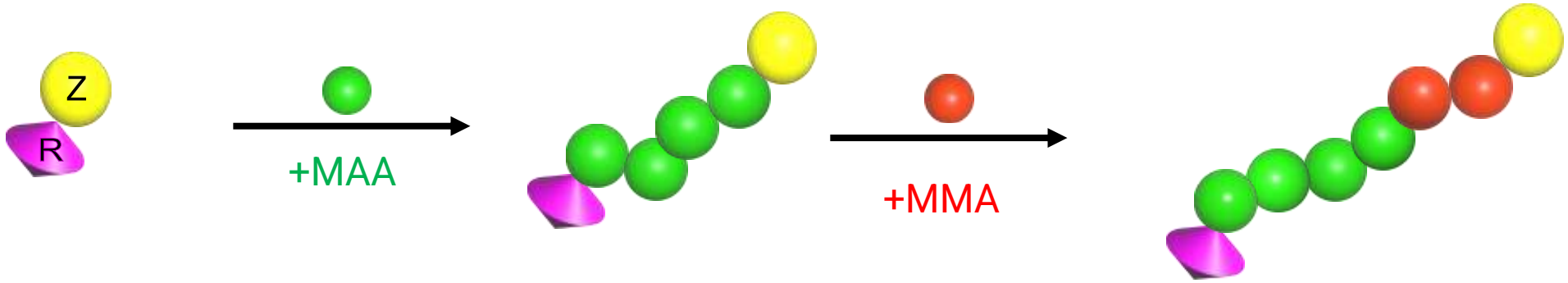


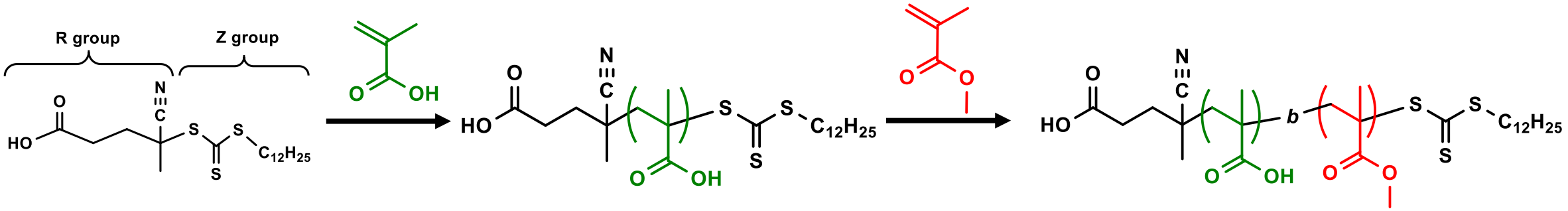


<< Compartmentalization >>

- ❖ High polymerization rate
- ❖ Low initiator-derived radical concentration
- ❖ Low k_p monomers

Methodology: Synthesis of amphiphilic macroRAFT agent





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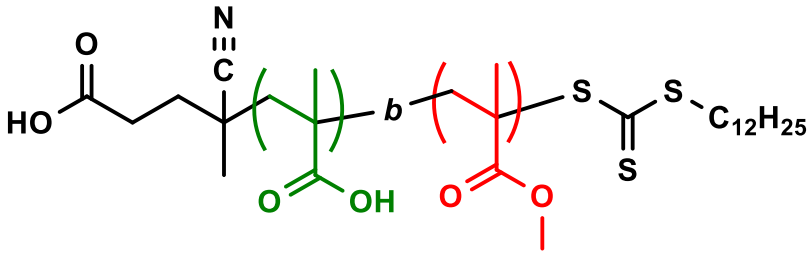
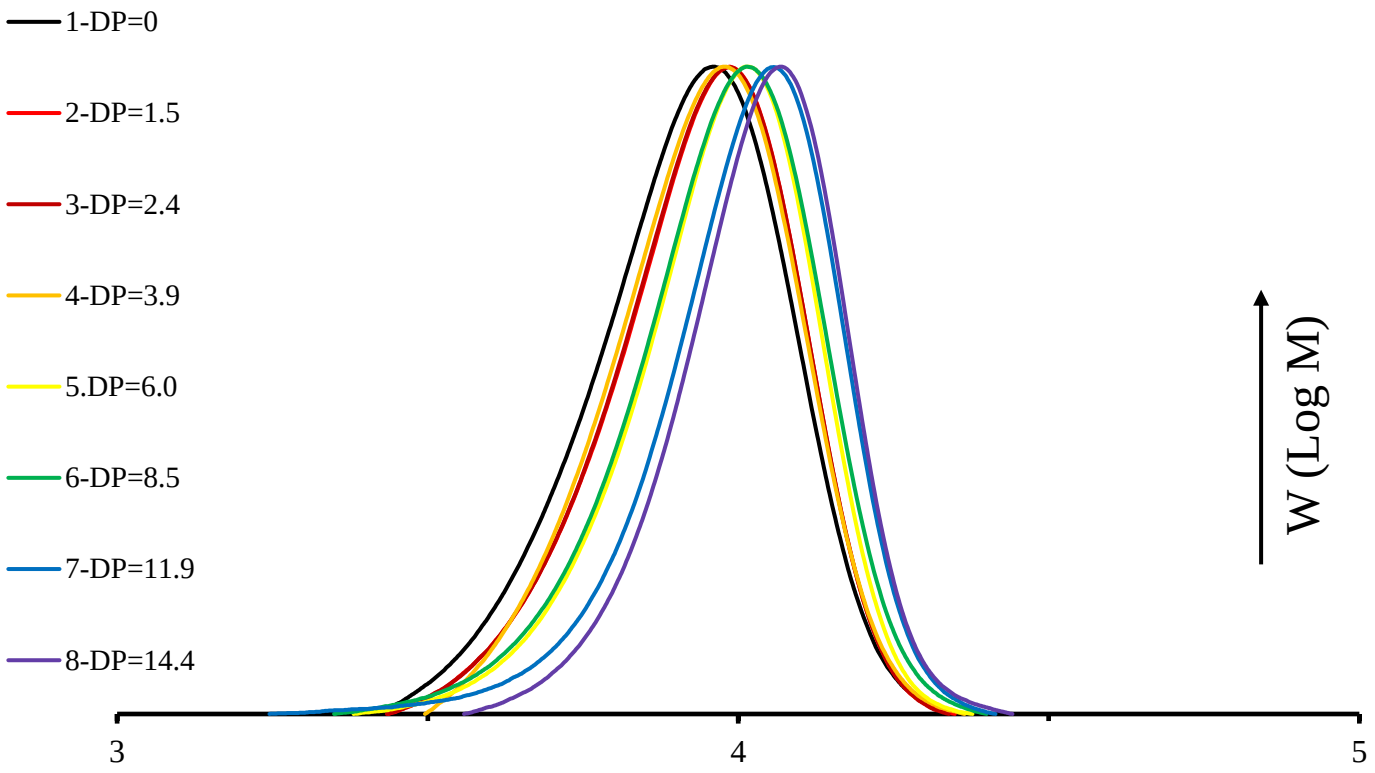
MacroRAFT optimization

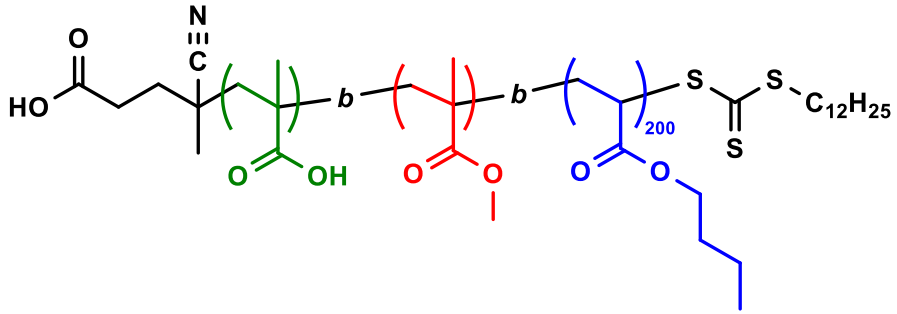
Effect of hydrophobic chain length



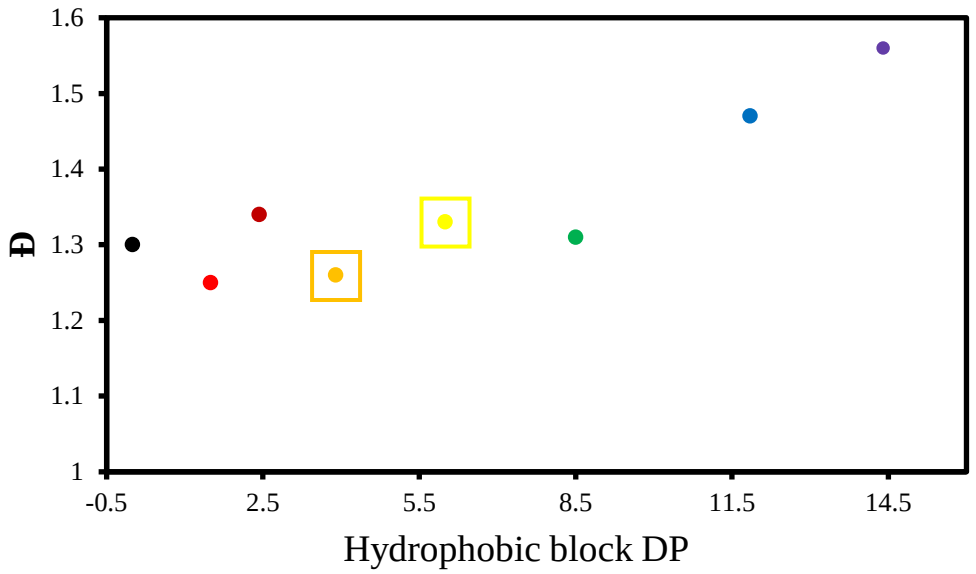


Seed latex synthesis (nanoreactors): RAFT emulsion polymerization

PBA seed DP=200



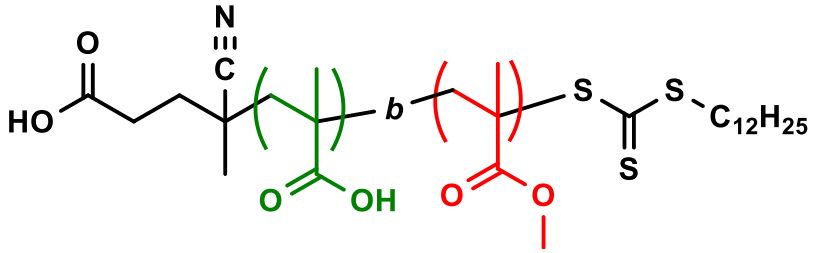
Seed *Đ* vs macroRAFT hydrophobic block DP

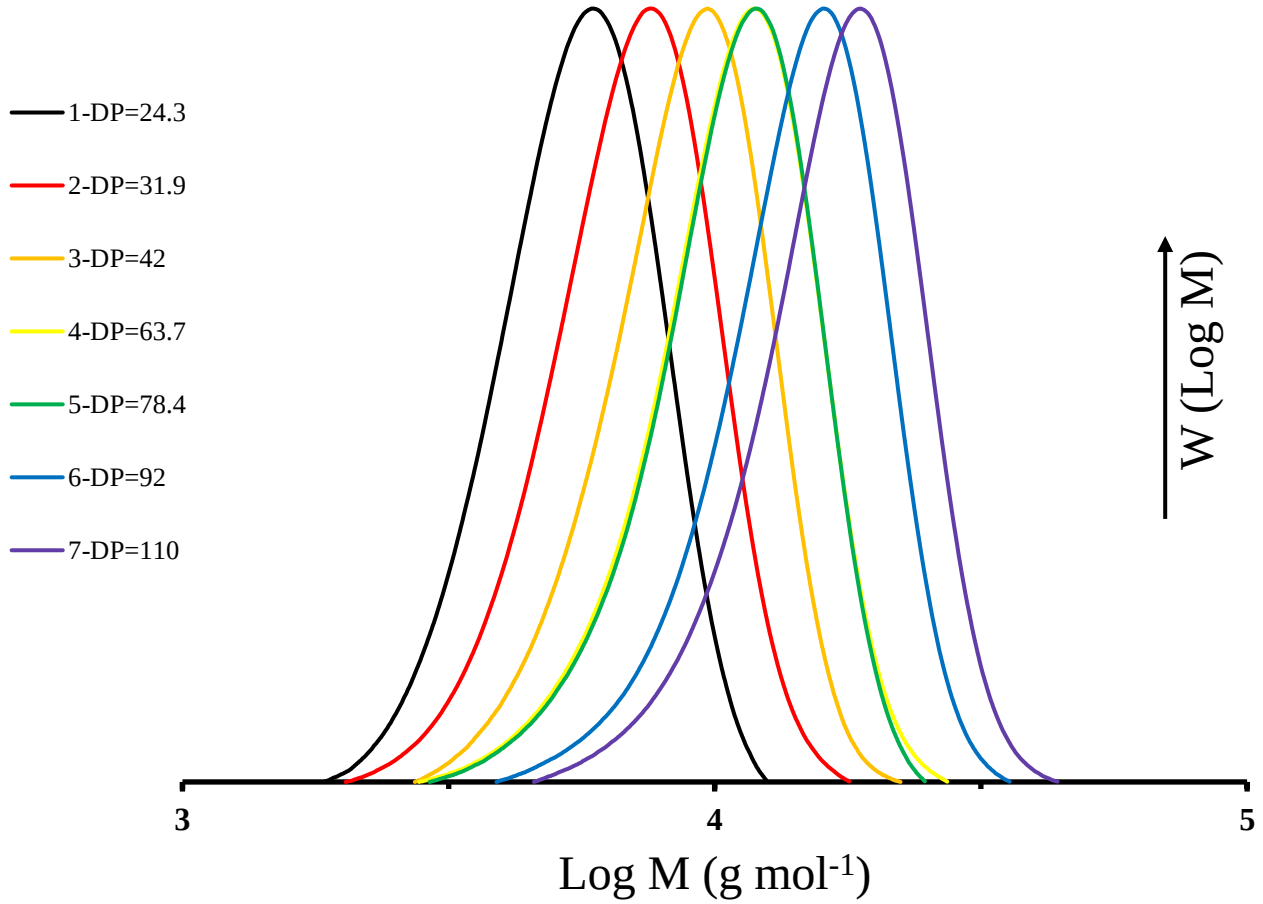


High viscosity by increasing the hydrophobic block DP

MacroRAFT optimization

Effect of hydrophilic chain length





Seed latex synthesis (nanoreactors): RAFT emulsion polymerization

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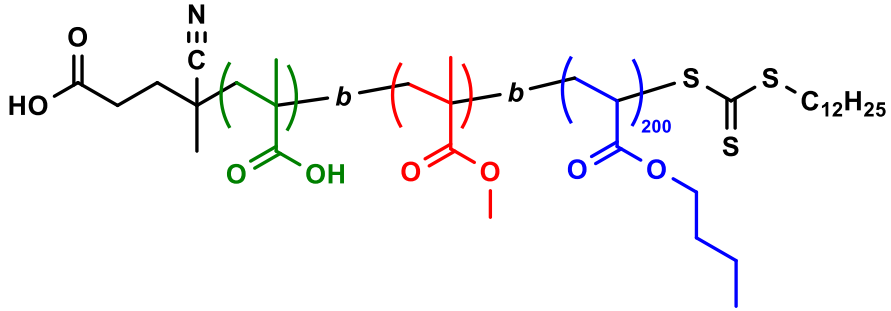
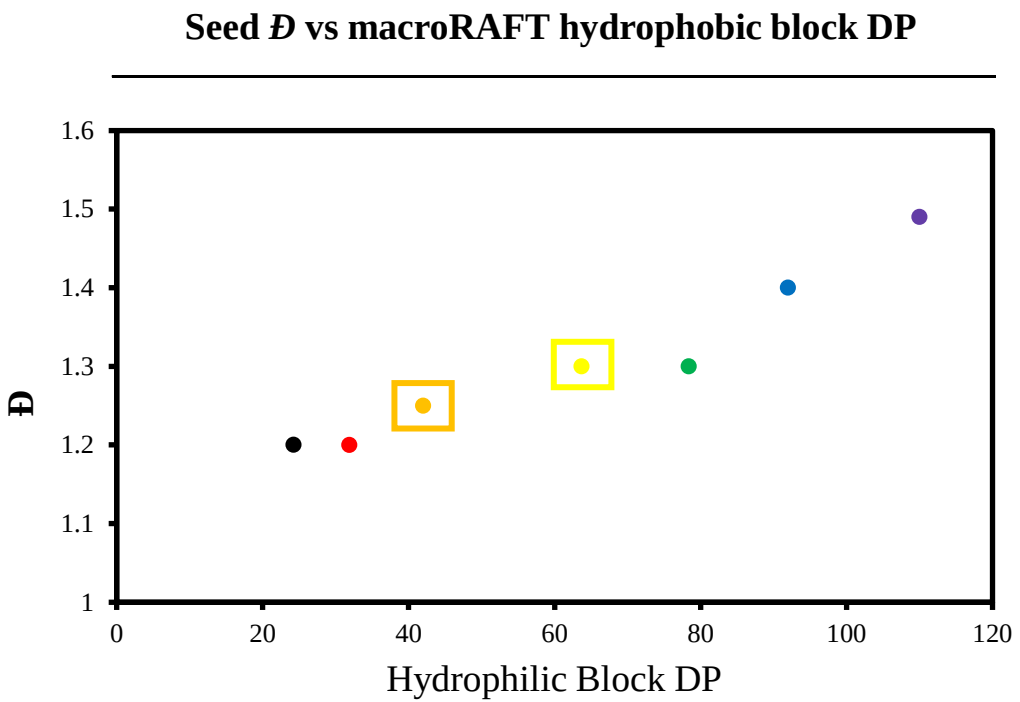
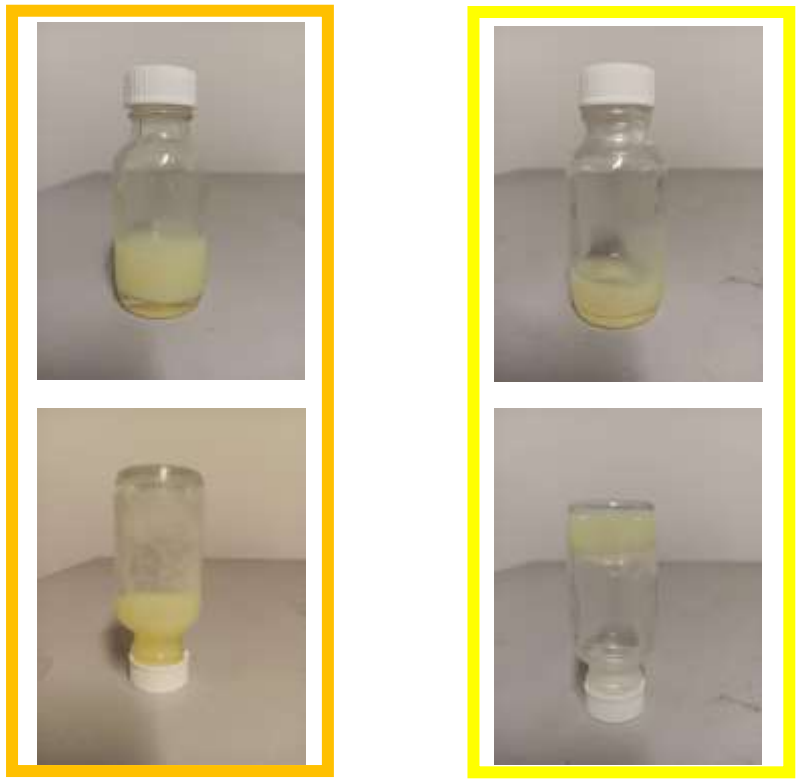


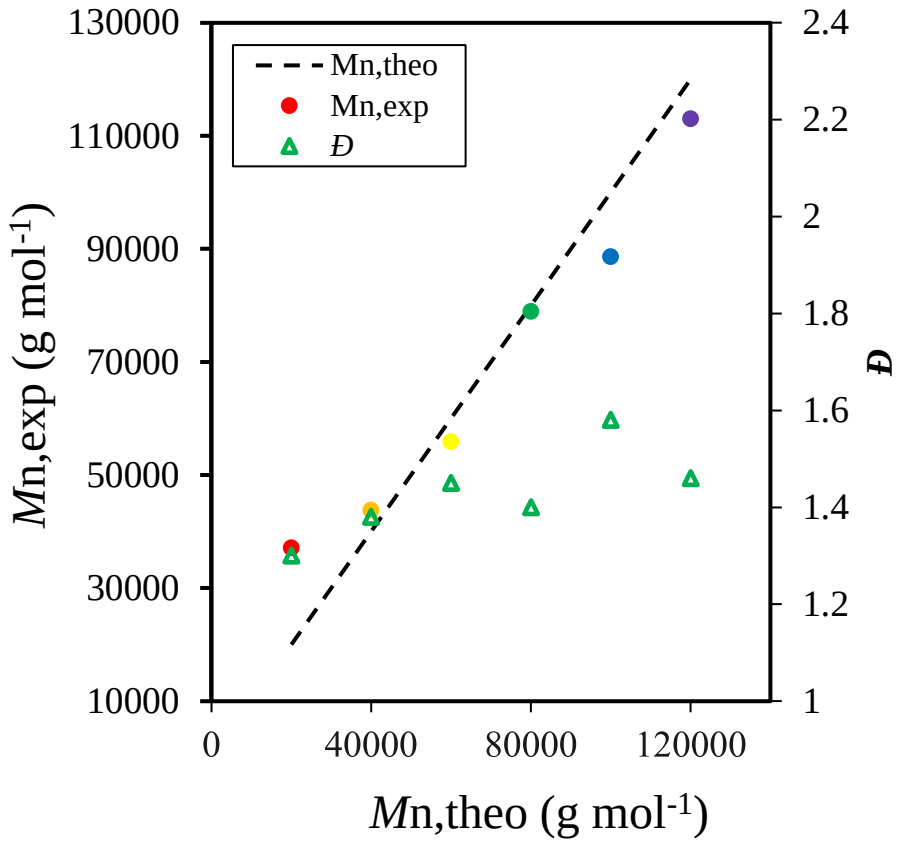




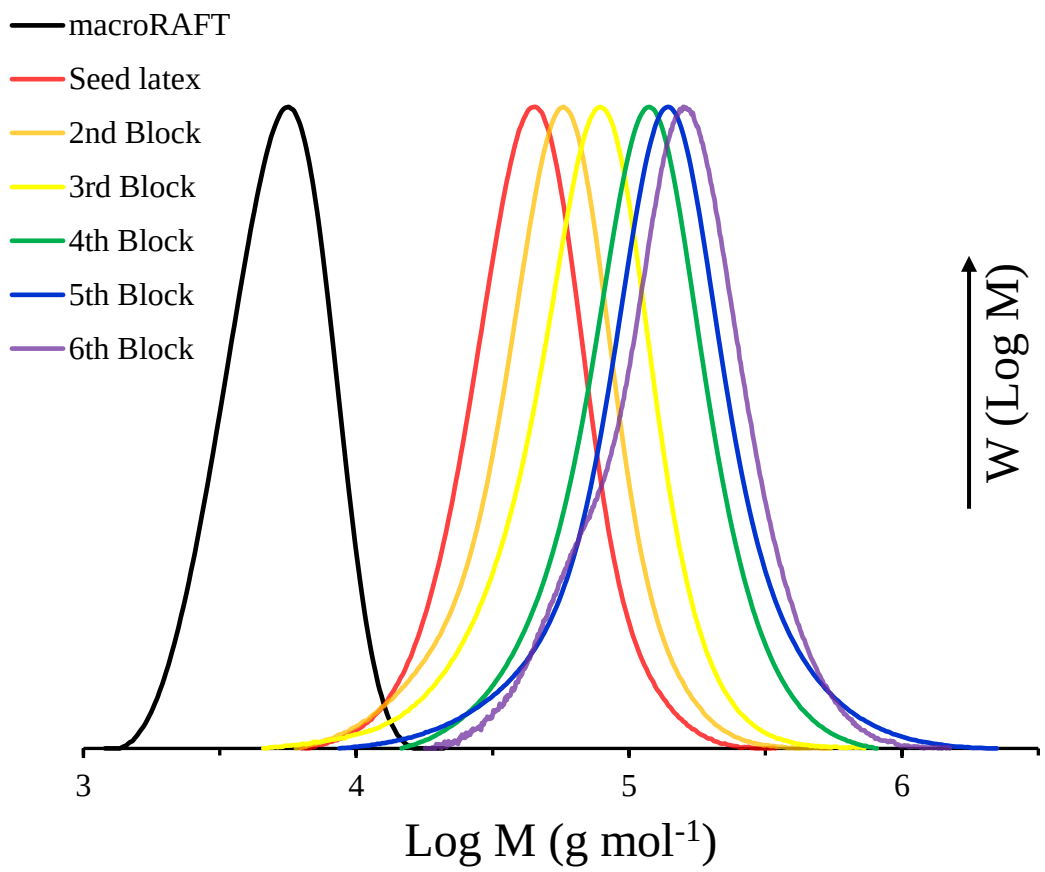
High viscosity by increasing the hydrophobic DP

Styrene hexablock copolymer latex particle films

Dispersity (*Đ*) and Mn,exp vs Mn,theo



Molecular weight distribution (MWD)



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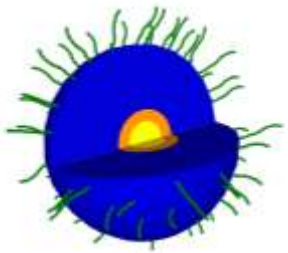
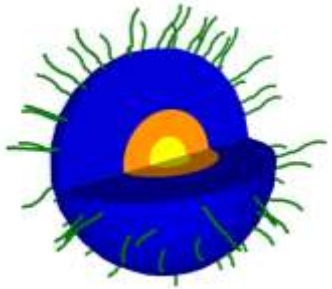
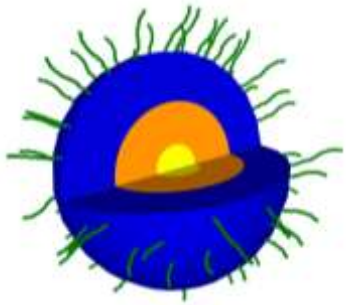
Styrene hexablock copolymer latex particle films



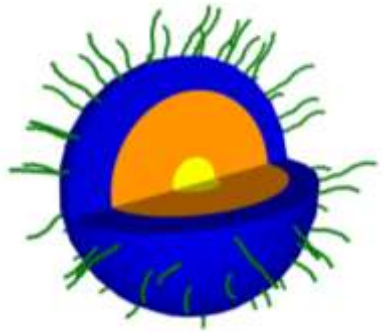
2nd Block
DP=300



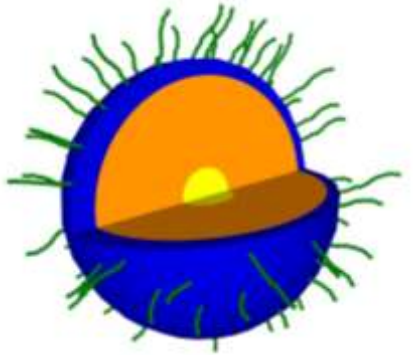
3rd Block
DP=400



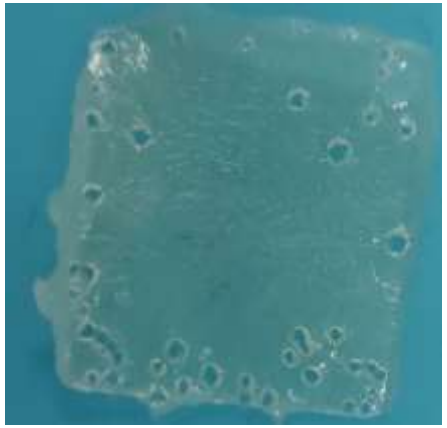
4th Block
DP=500



5th Block
DP=600



6th Block
DP=700



Poor mechanical properties by increasing the styrene block numbers

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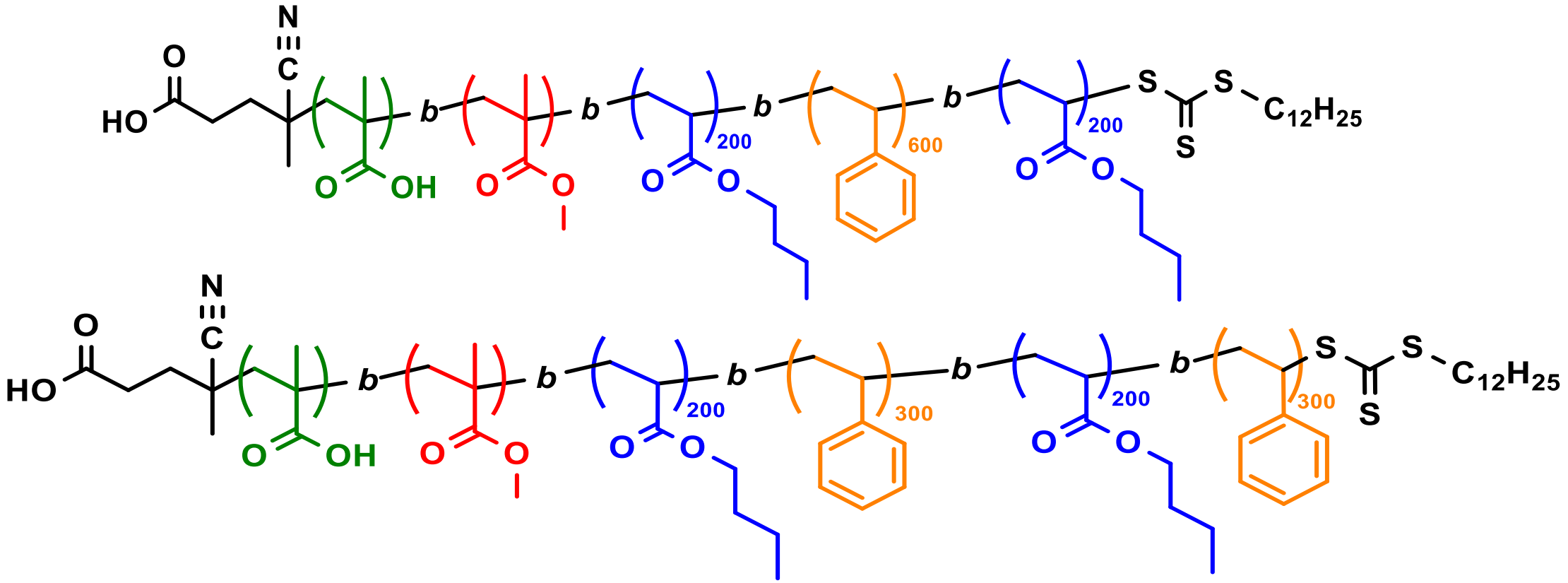
Future work

Sequential copolymerization

Microphase separation



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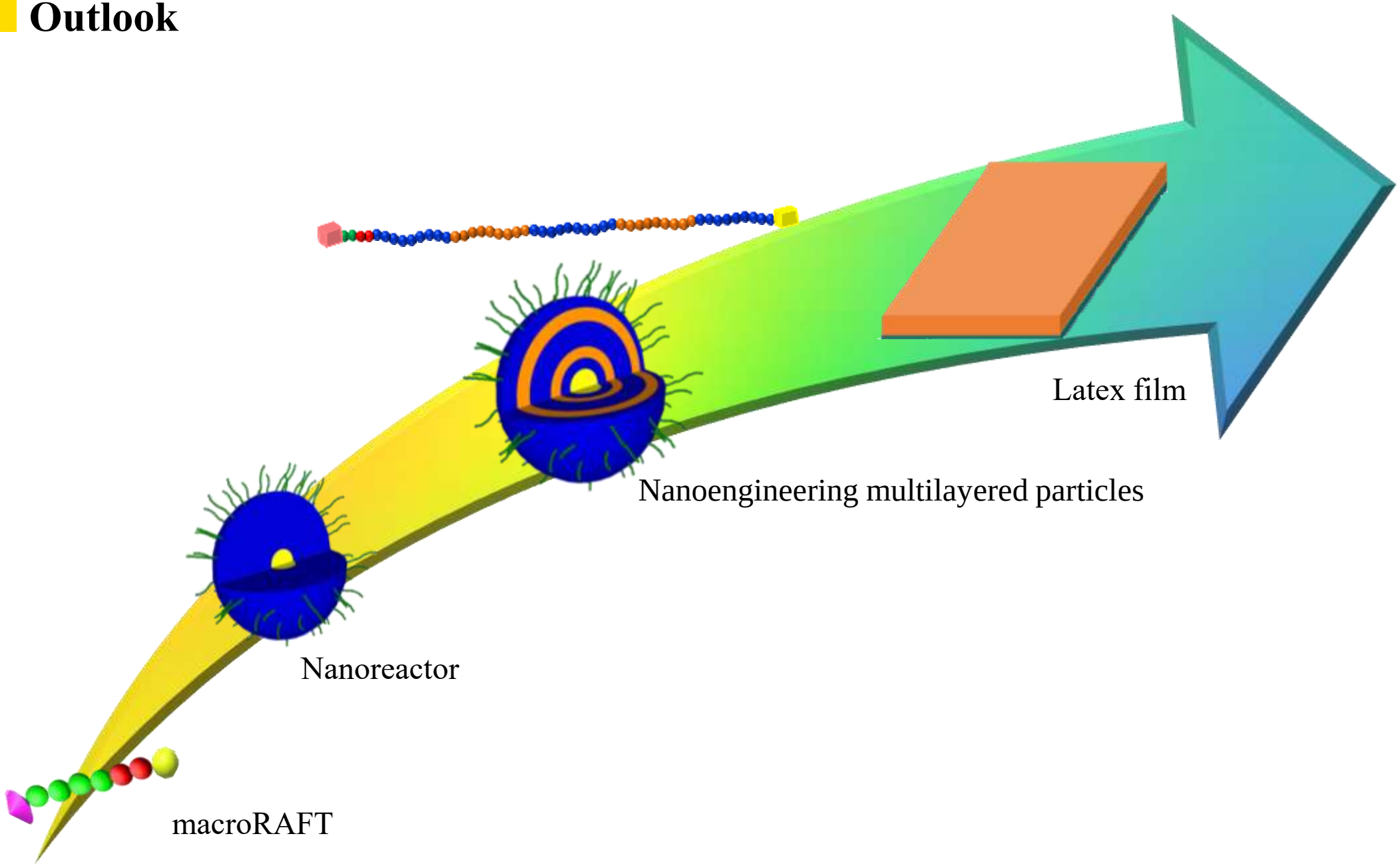
Outlook


Latex film
Nanoengineering multilayered particles
Nanoreactor
macroRAFT

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Centre for Advanced Macromolecular Design

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