

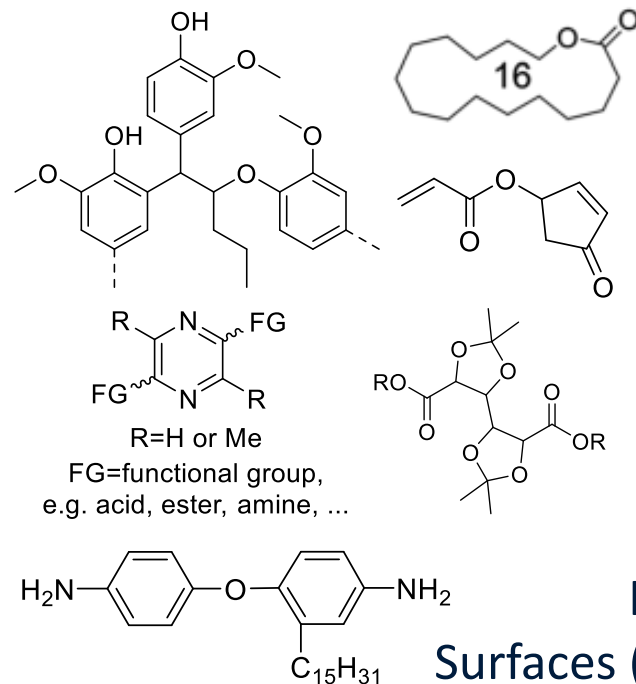
Biobased Photopolymer Resin for 3D Printing Containing Dynamic Imine Bonds for Fast Reprocessability

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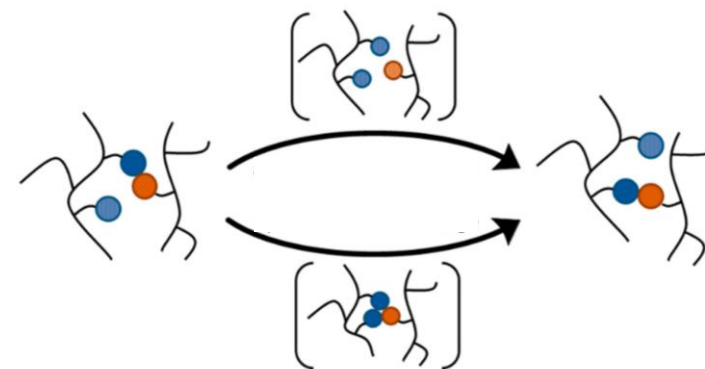
The Sustainable Symposium: the future of 3D printing
January 21, 2025



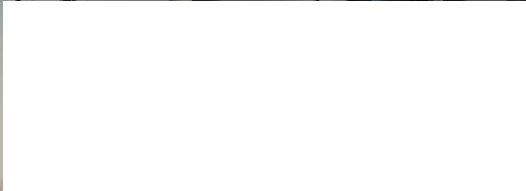
Sustainable Polymer Synthesis Group



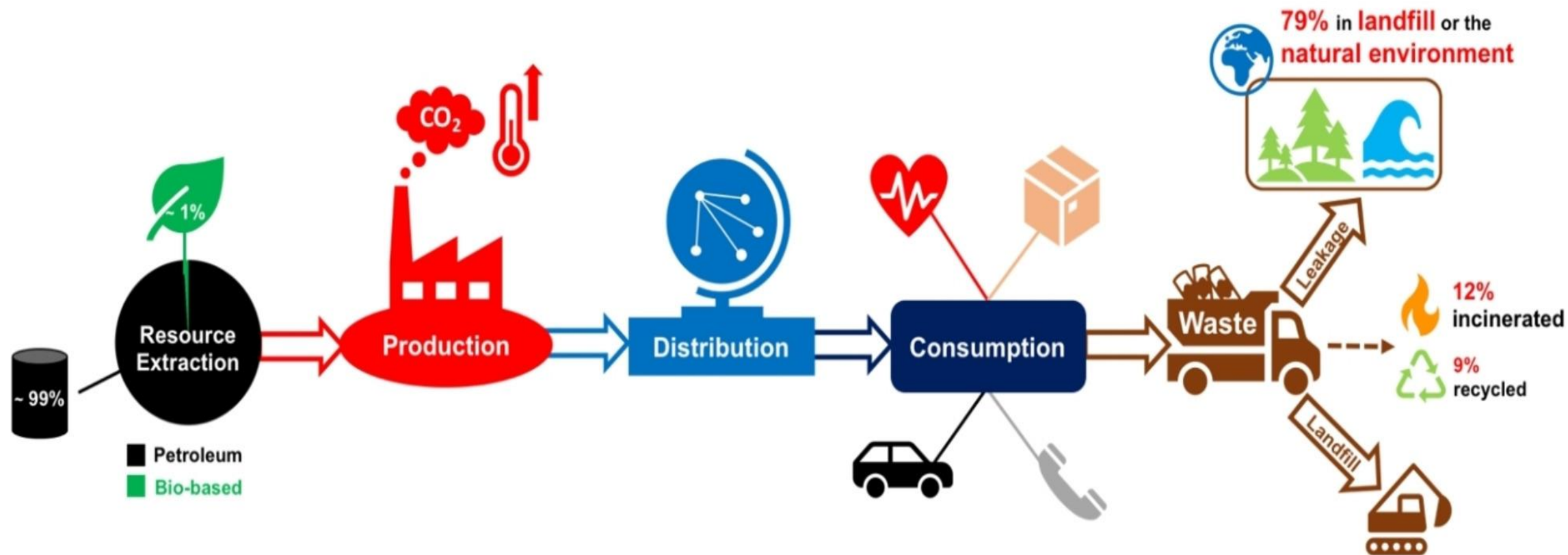
bulk, hydrothermal, aqueous (latex), ...



High performance polymers
Surfaces (coatings, adhesives, membranes, ...)
Biomedical applications (with MERLN)



Current linear, petroleum based economy



Towards a circular economy

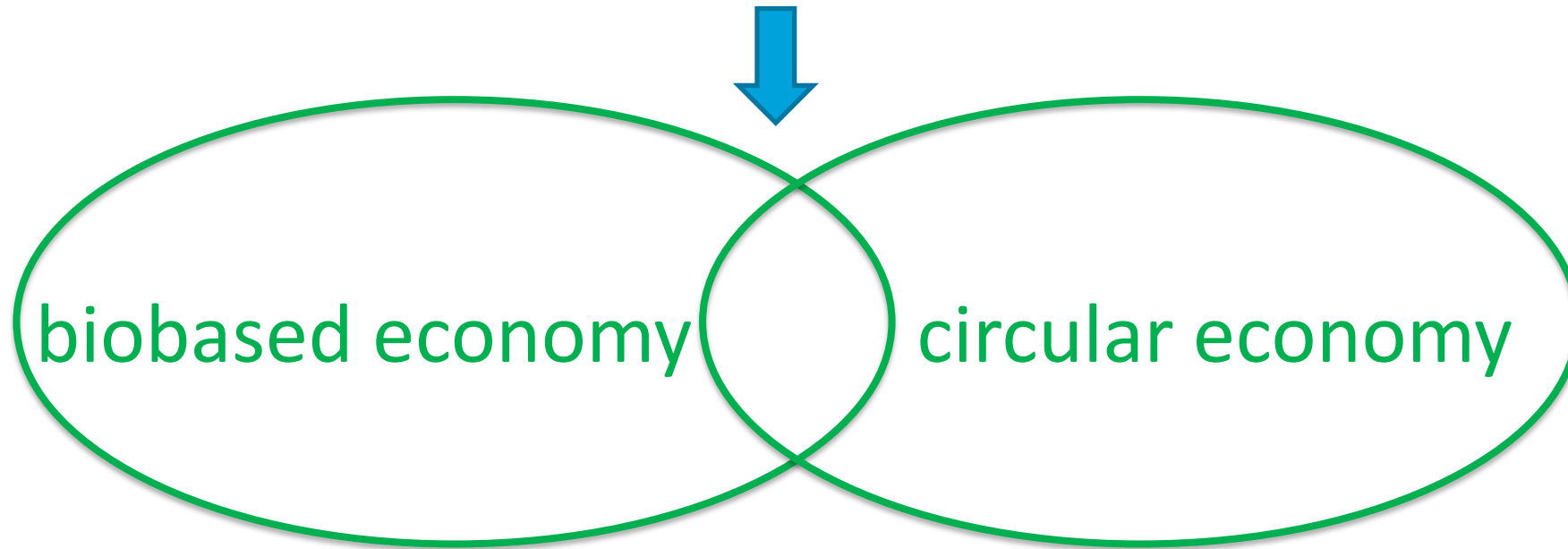


transforming the current European economy into one that is sustainable, climate neutral, and circular by 2050



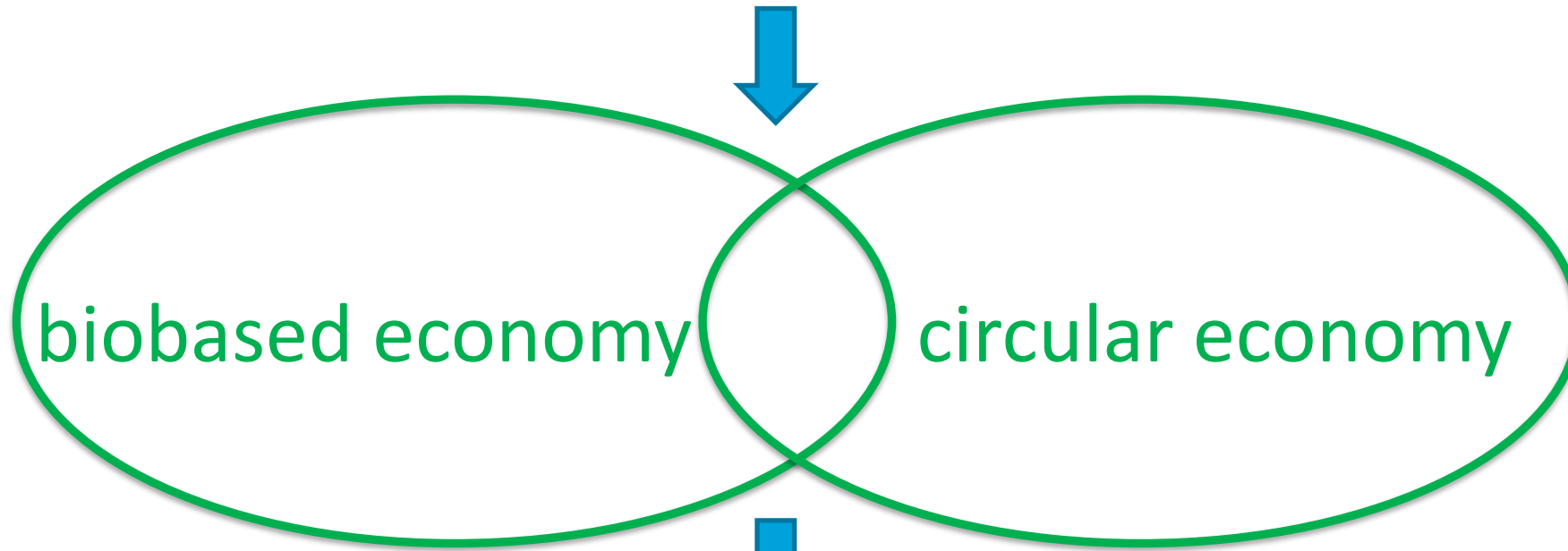
Goal

sustainable polymer thermoset materials

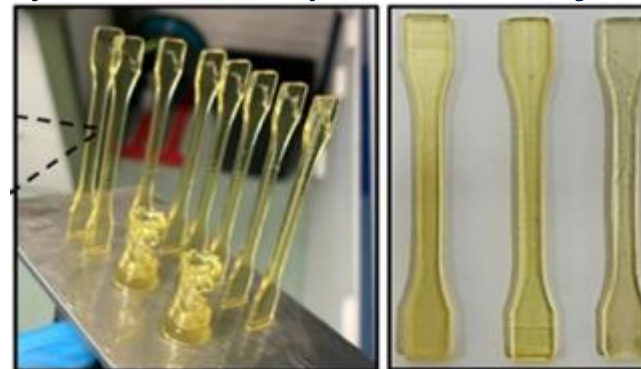


Goal

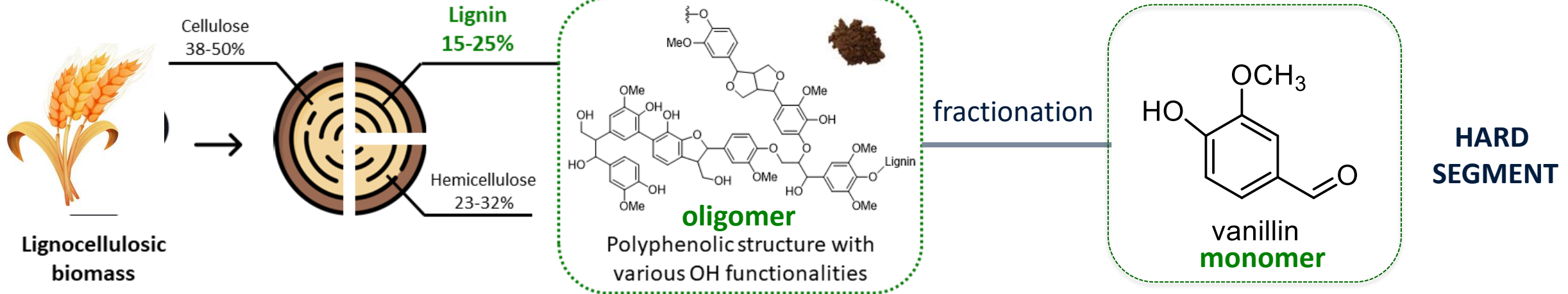
sustainable polymer thermoset materials



recyclable 3D printed objects

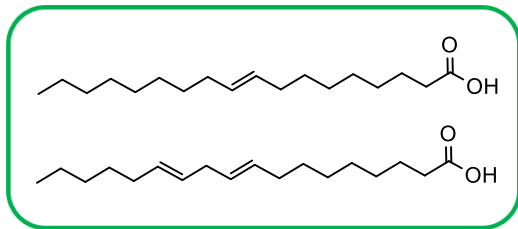


Biobased economy

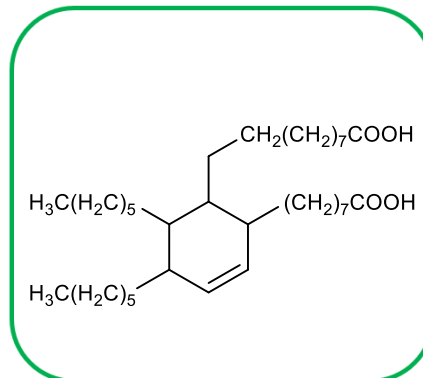


Biomass-derived/
Non-petroleum based
carbon neutral

Biomass delivered fatty acid



Dimerized fatty acid (Dimer acid)
Example of structure



SOFT SEGMENT

Circular economy

Thermosets

- + mechanical properties
- + insoluble

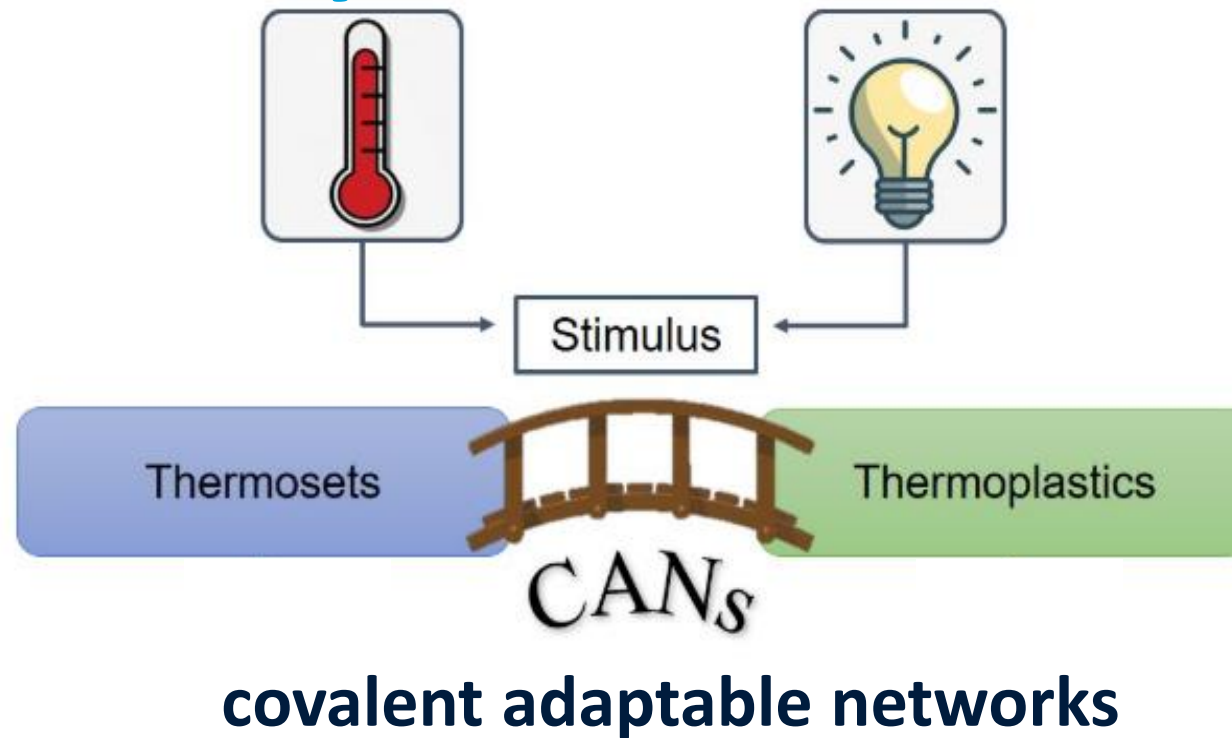
- permanent shape
- no processing possible

Thermoplastics

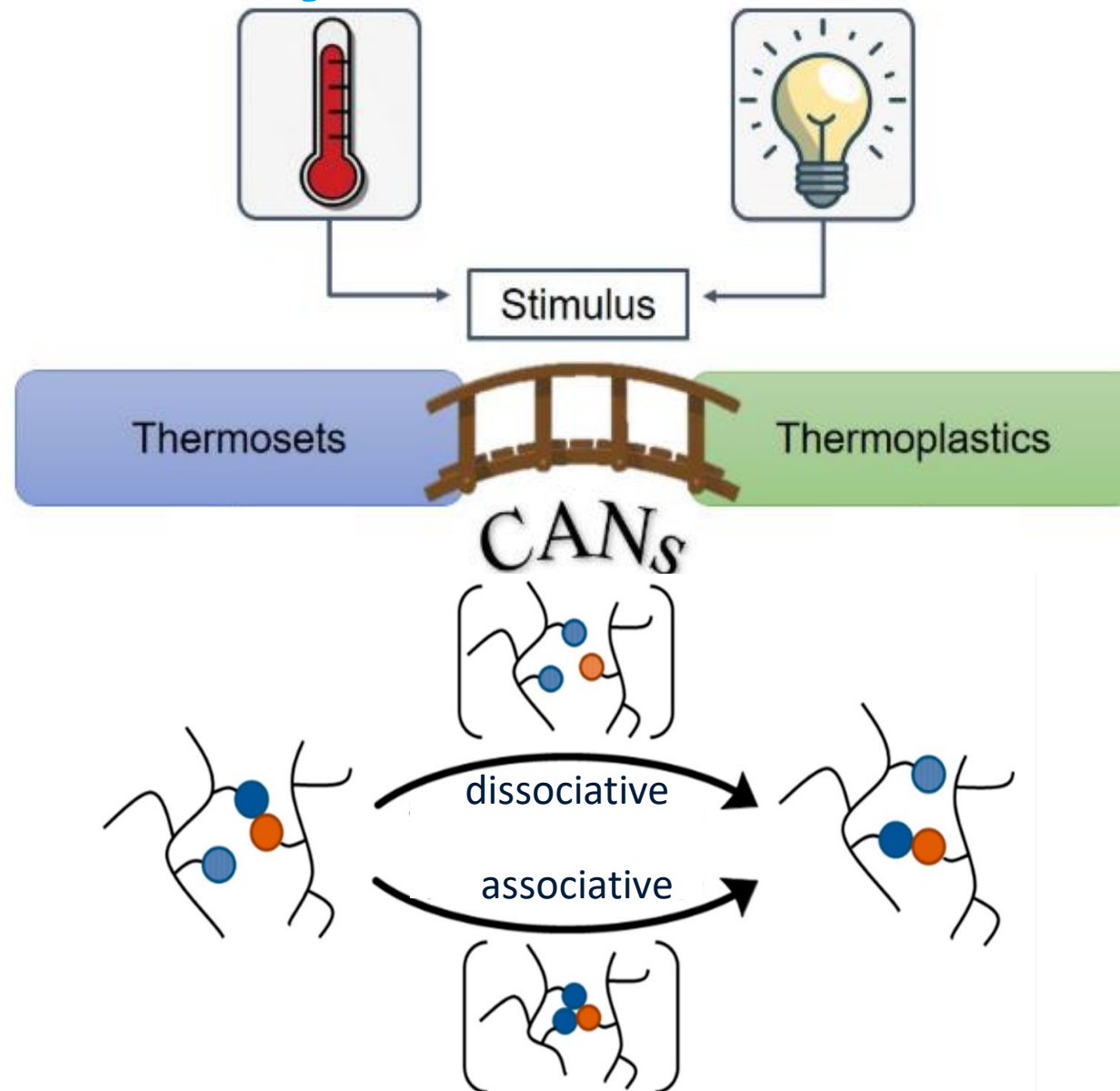
- + malleable and processable
- + recycling

- creep
- solvent resistance

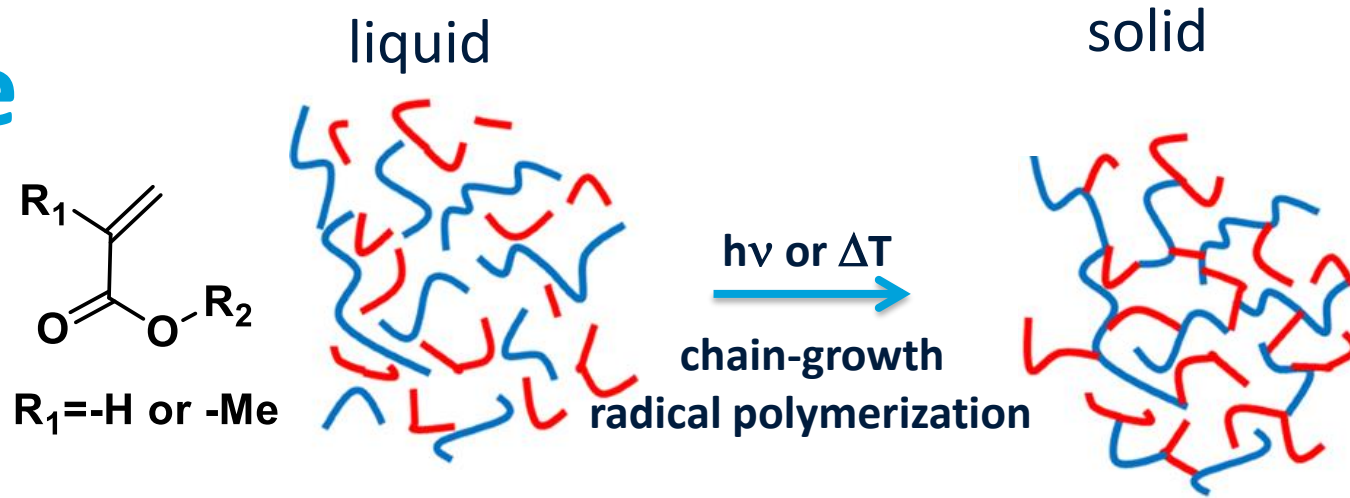
Circular economy



Circular economy



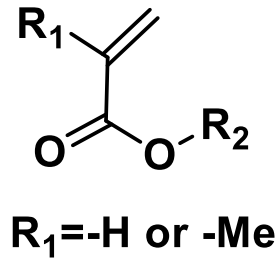
Challenge



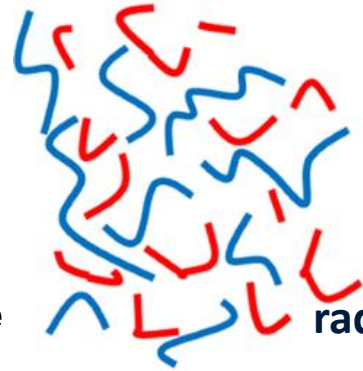
acrylic thermosets

- good mechanical performance
 - thermal stability
 - solvent resistance

Challenge

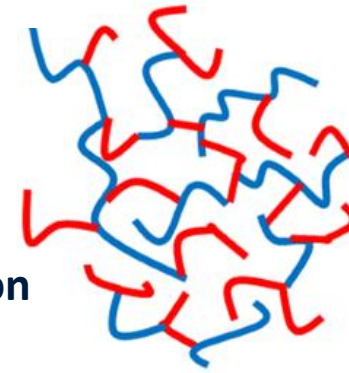


liquid



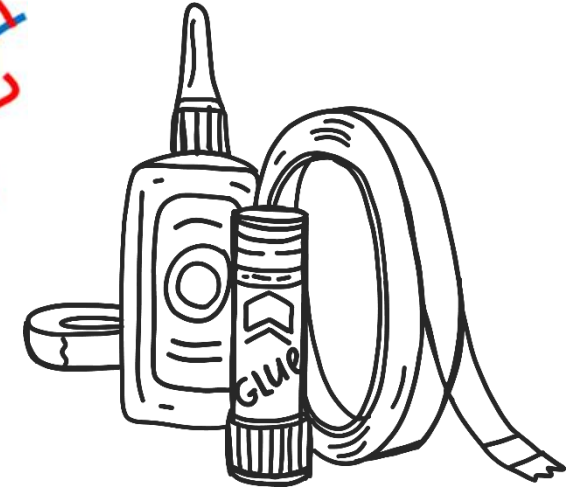
chain-growth
radical polymerization

solid

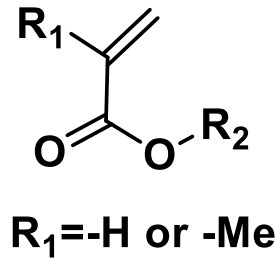


acrylic thermosets

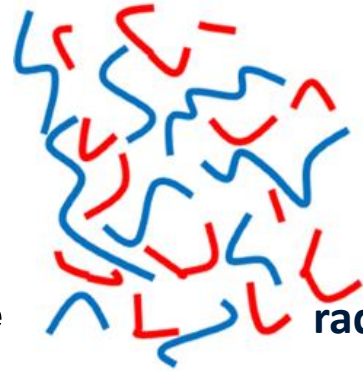
- good mechanical performance
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Challenge



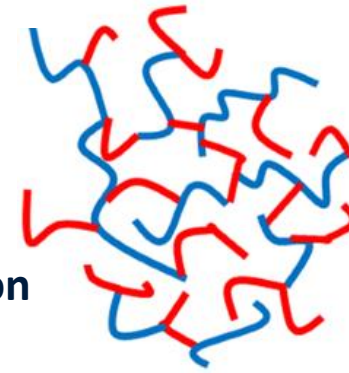
liquid



$h\nu \text{ or } \Delta T$

chain-growth
radical polymerization

solid



acrylic thermosets

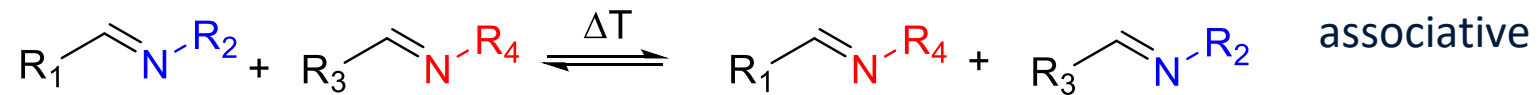
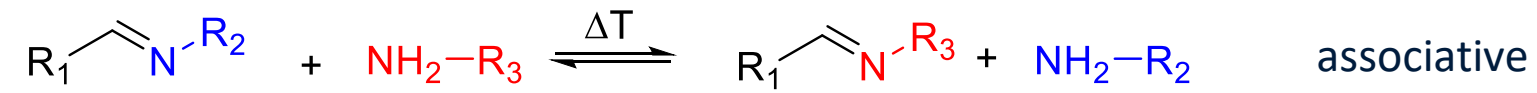
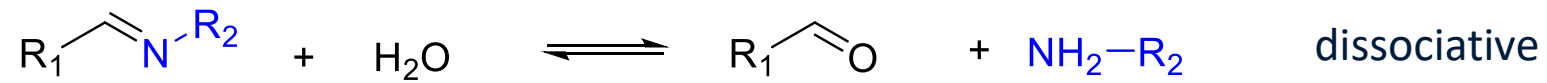
BUT

- from fossil resources
- not recyclable,

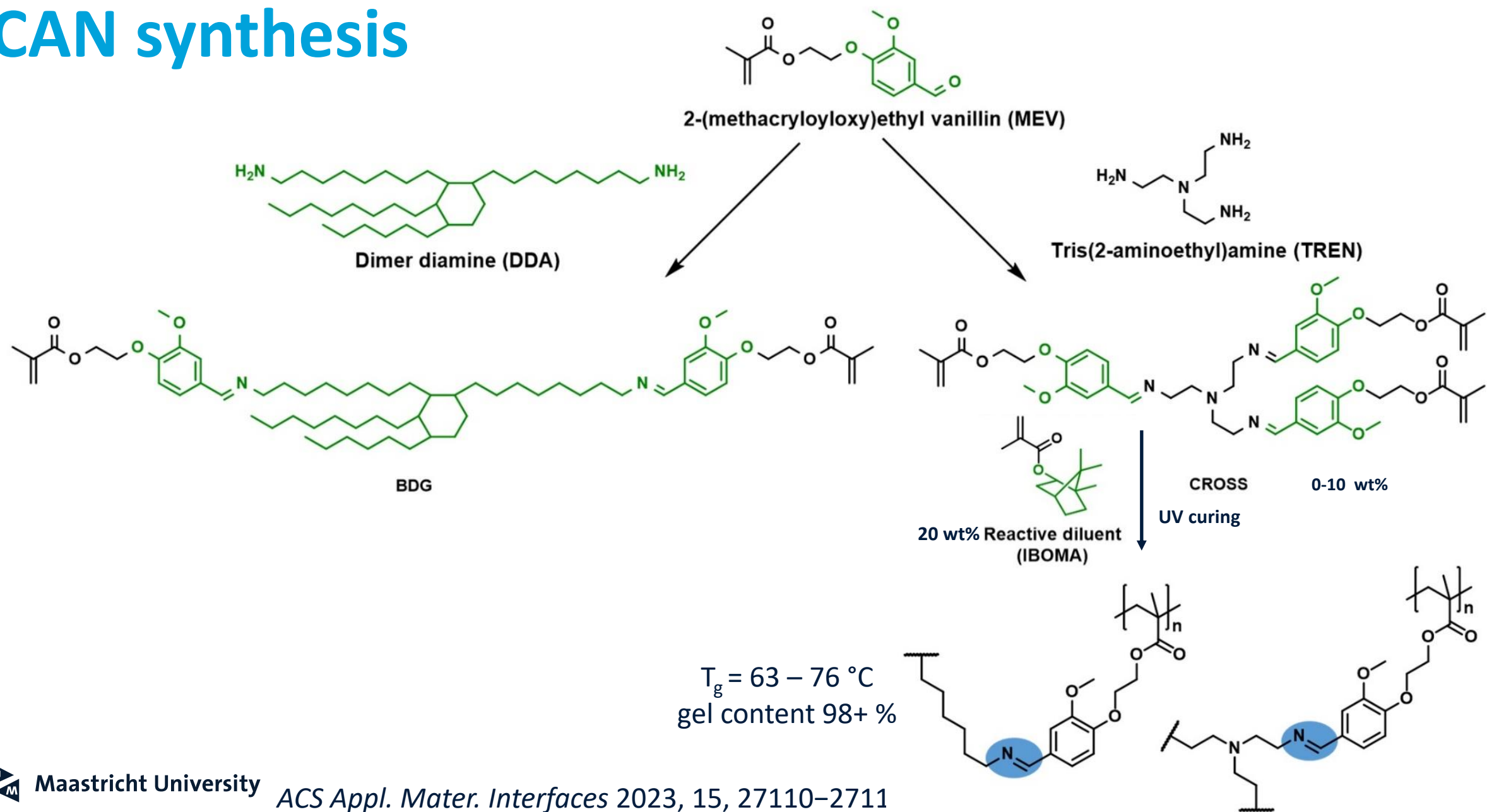
resulting in disposal in landfills or incineration of waste



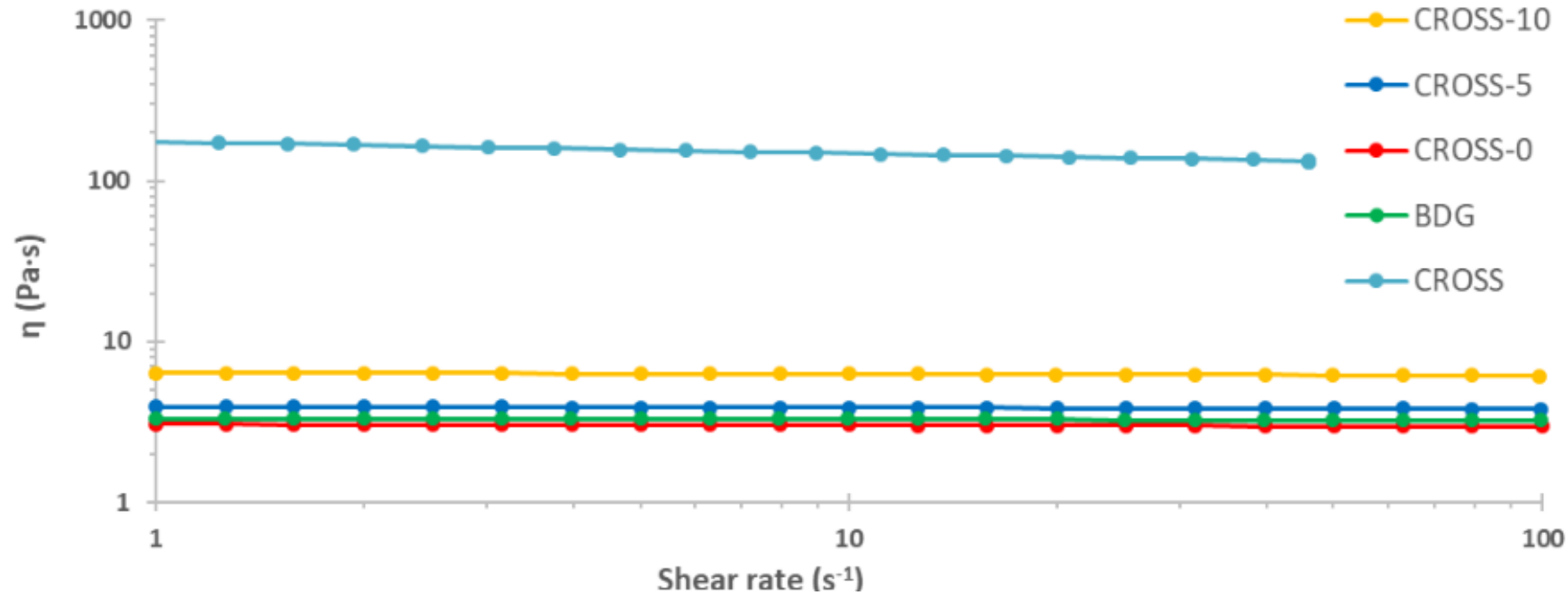
Reversible imine CANs



CAN synthesis

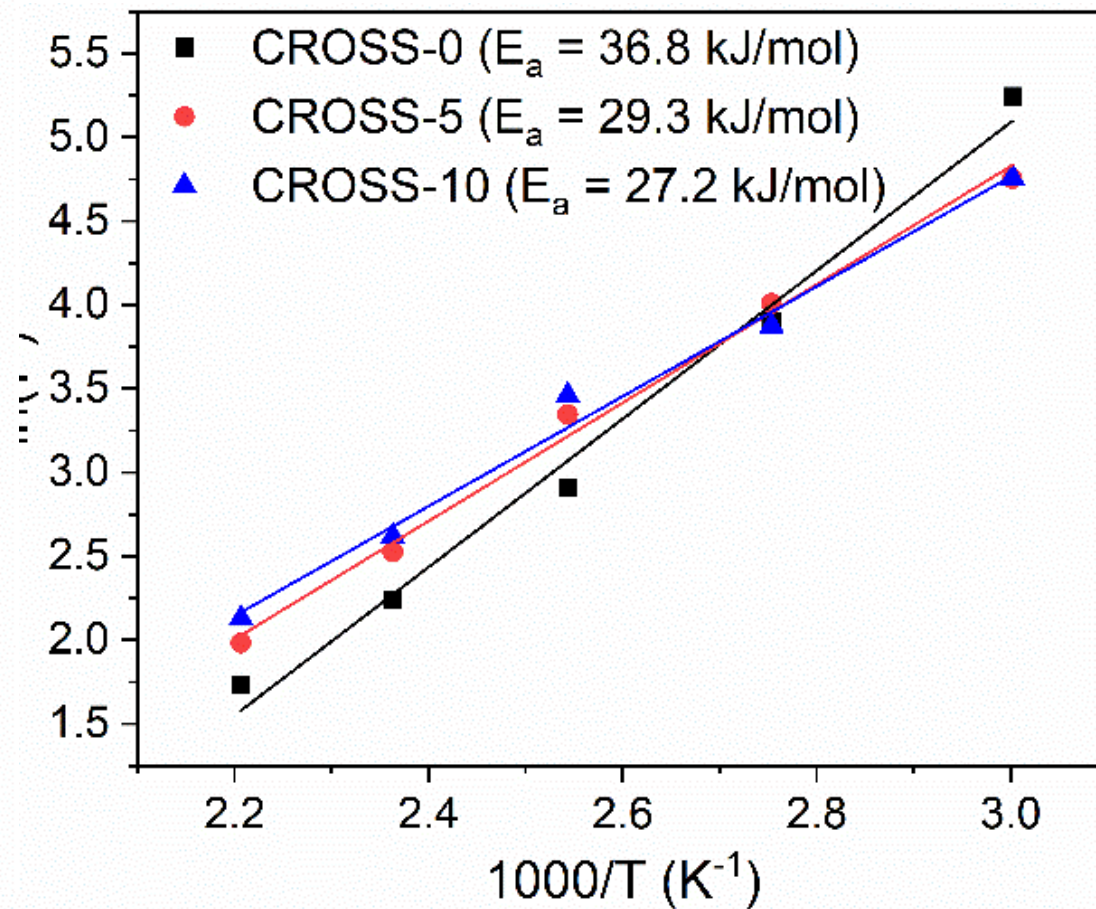
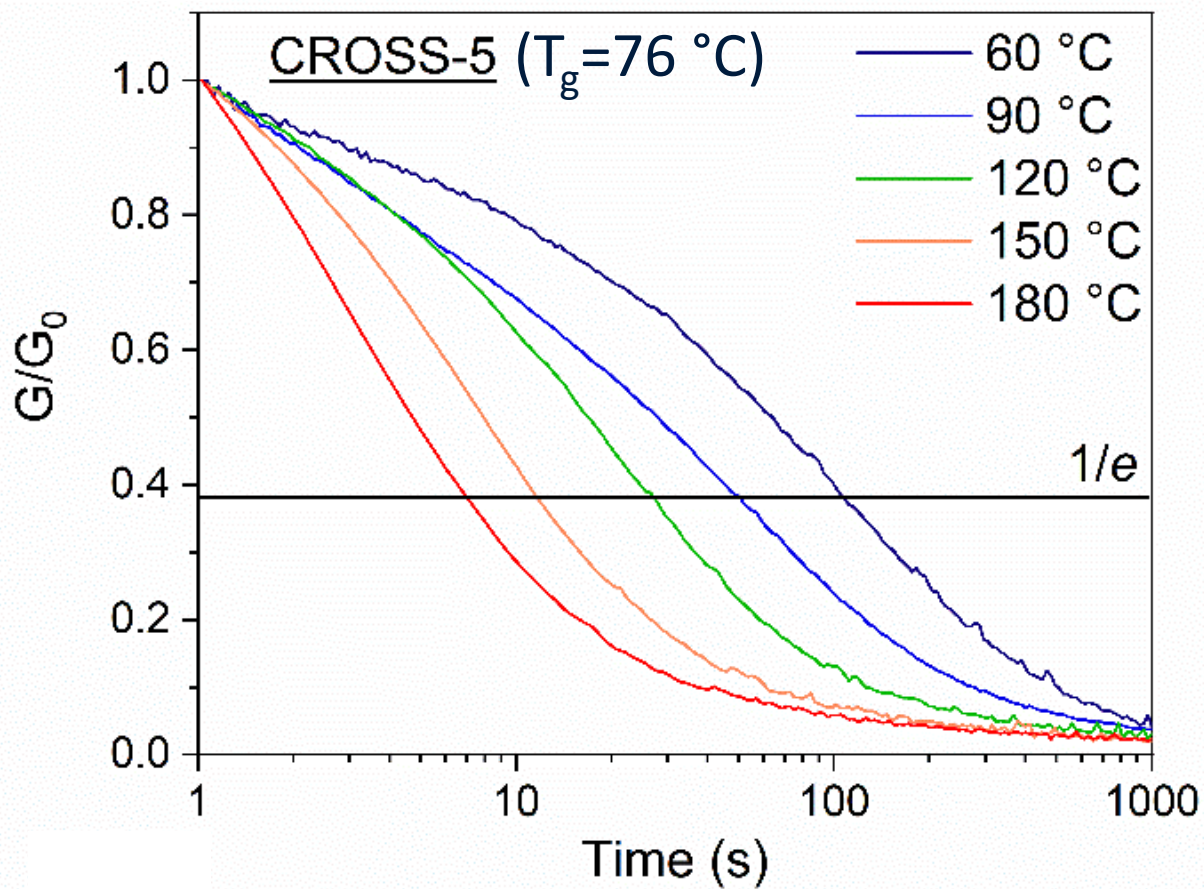


Viscosity of ink formulations

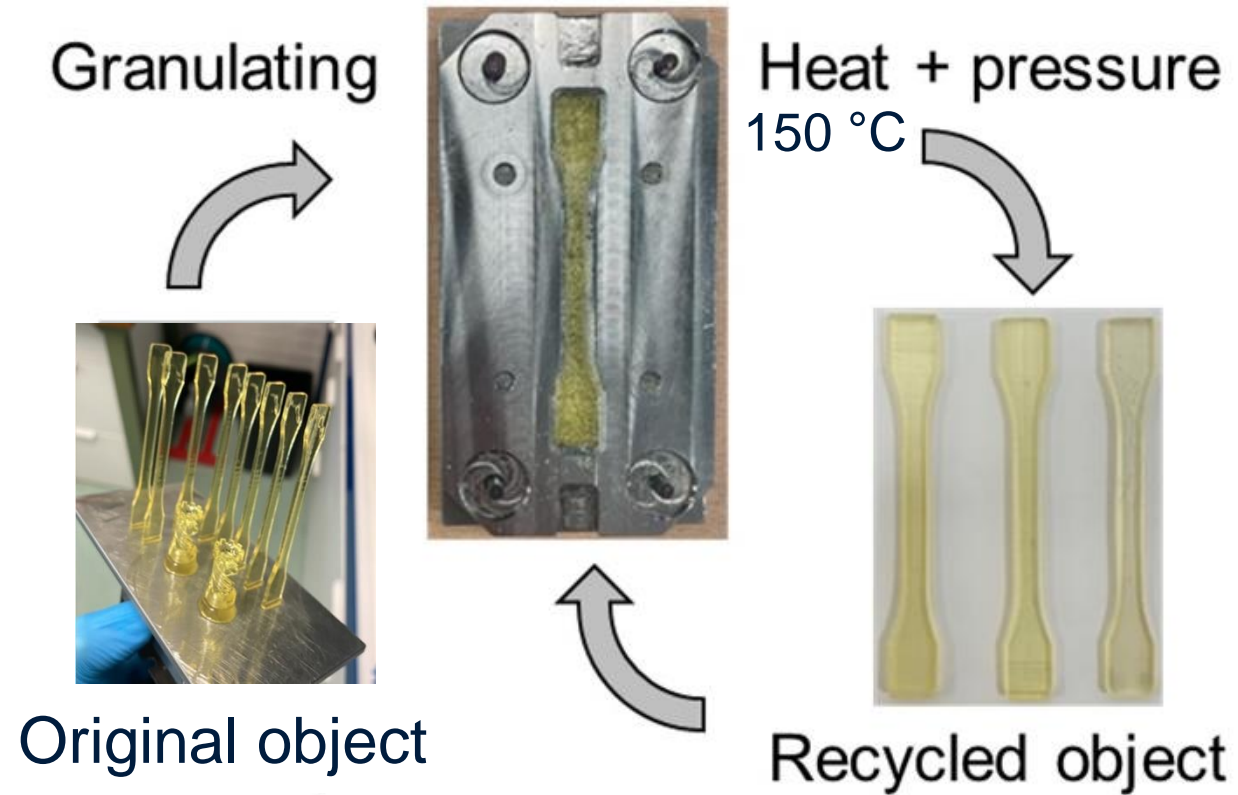


formulation	CROSS (wt %)	BDG (wt %)	IBOMA (wt %)	biobased content ^{cf} (%)
CROSS-0	0	80	20	75
CROSS-5	5	75	20	74
CROSS-10	10	70	20	73

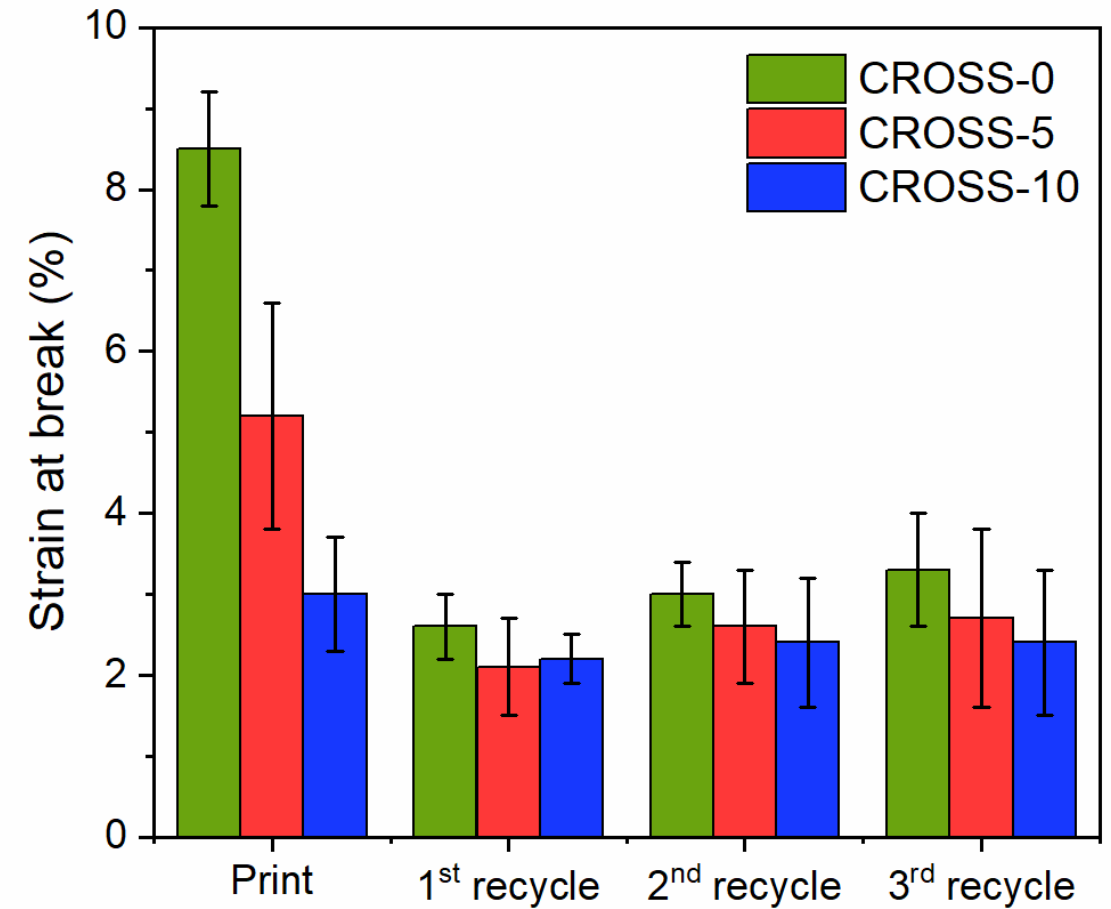
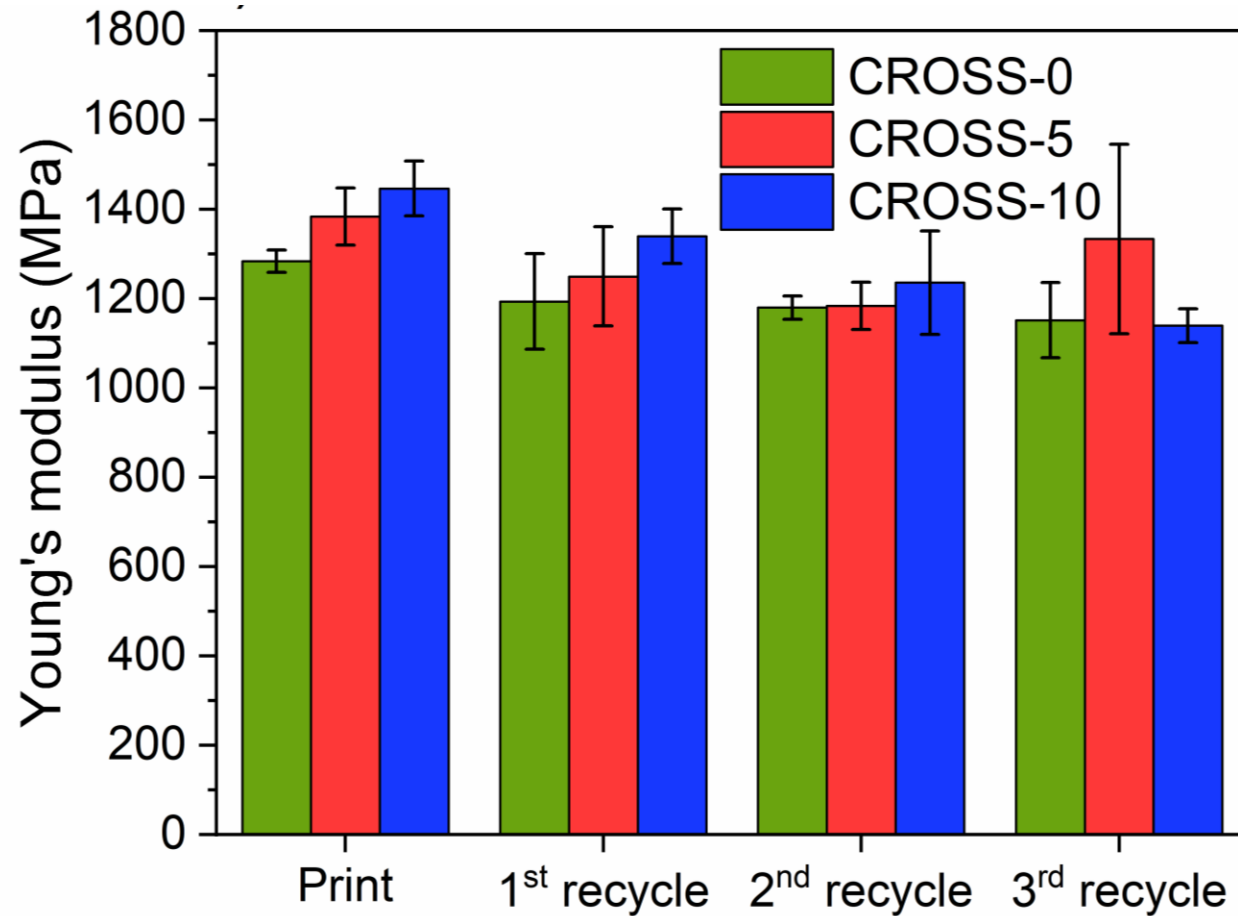
Stress relaxation



Reprocessability

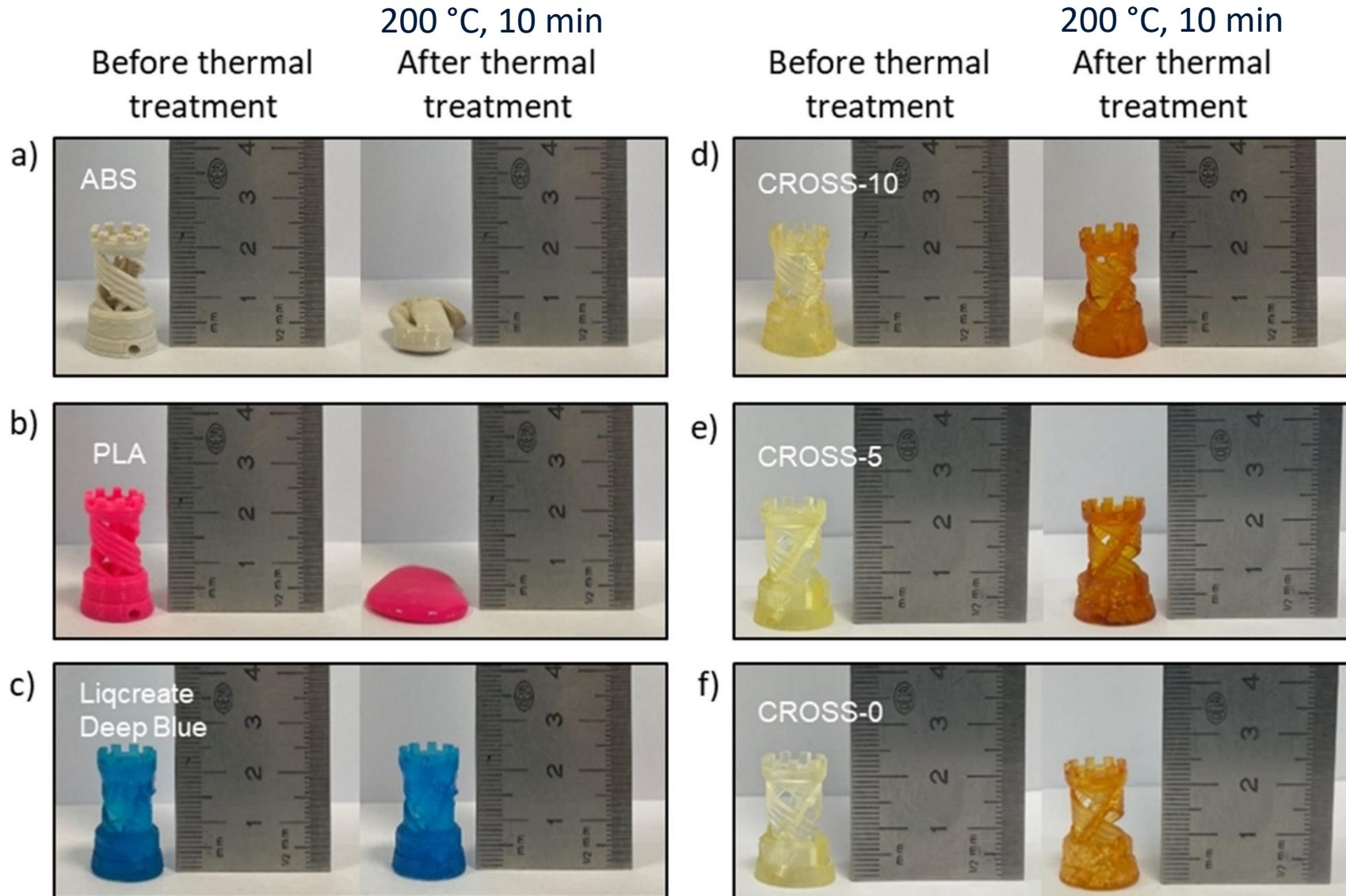


Reprocessability – mechanical properties



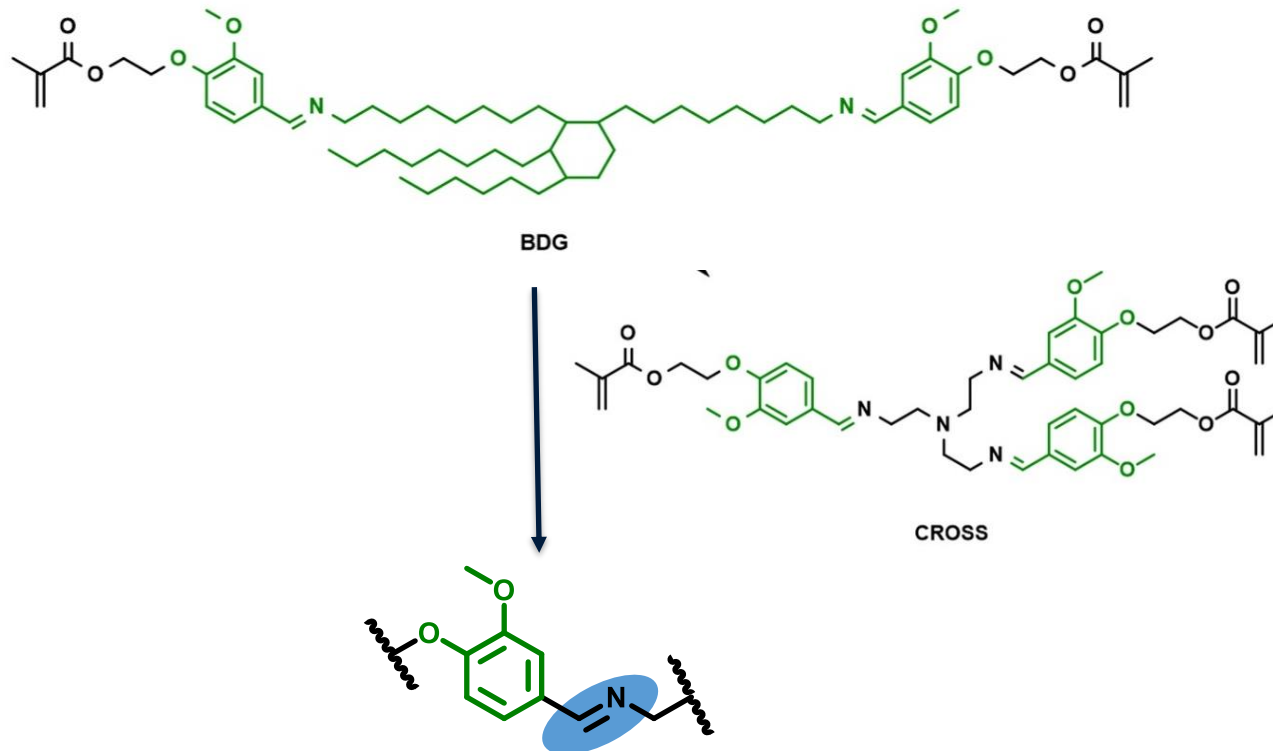
Application potential

3D photoprinting



Conclusions

- New biobased and recyclable resins prepared for UV curable 3D printing



- Imine CANs render polymethacrylate networks recyclable



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