Biobased 2,5-bis(hydroxymethyl)furan Polyesteramide for Enhanced Solar Cell Encapsulation

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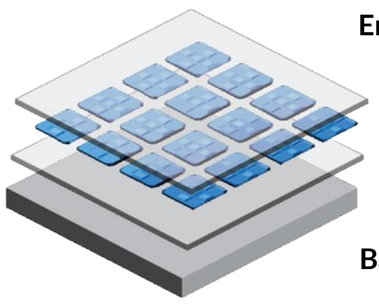
INTRODUCTION

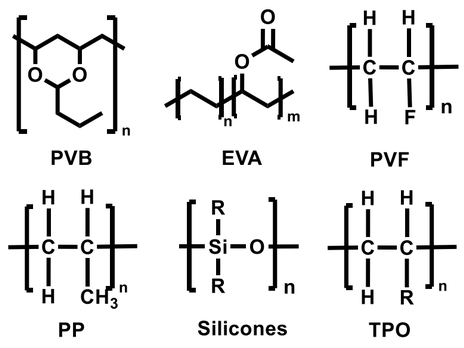
Background

Solar cell



Encapsulant layer

Backsheet Layer



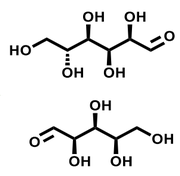
- ❑ Protection from weather-related degradation
- ❑ Safeguard from mechanical damage
- ❑ Electrical insulation between the components
- ❑ Ensure long-term durability of the device

Commercial materials

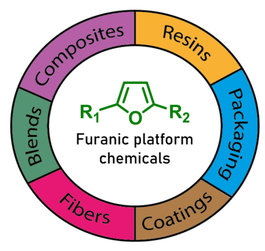
Petroleum-based with several drawbacks

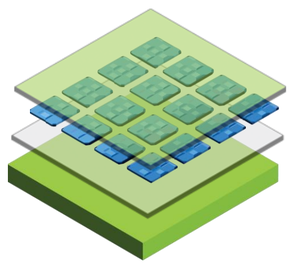
Objectives

Elephant Grass



Hexoses and pentoses sugars

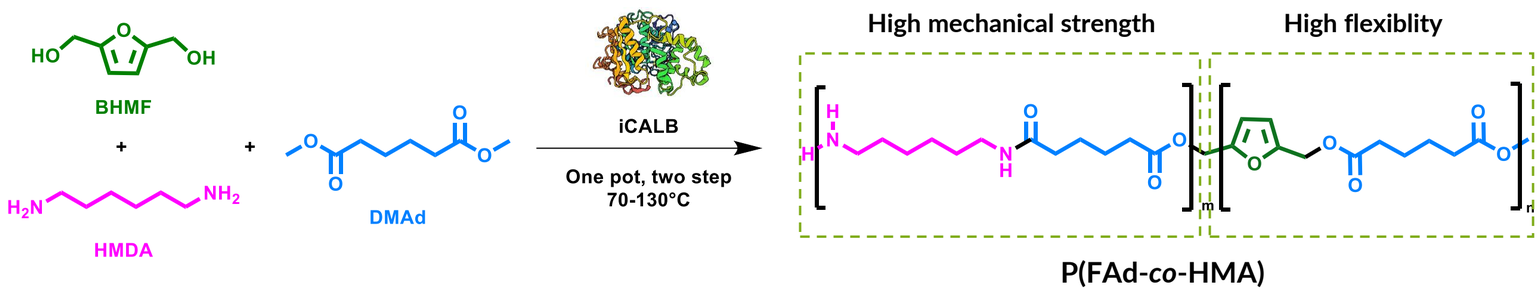




Bio-based polymer encapsulant/backsheet

- ❑ Improved mechanical strength
- ❑ Low T_g

METHODOLOGY



Polymer	Ratio (%)		
	DMAd	BHMF	HMDA
P(FAd-*co*-HMA)10	50	40	10
P(FAd-*co*-HMA)12.5	50	37.5	12.5
P(FAd-*co*-HMA)25	50	25	25
P(FAd-*co*-HMA)37.5	50	12.5	37.5

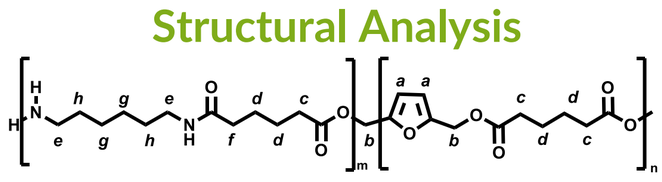
Biobased monomers → **Enzymatic polymerization**

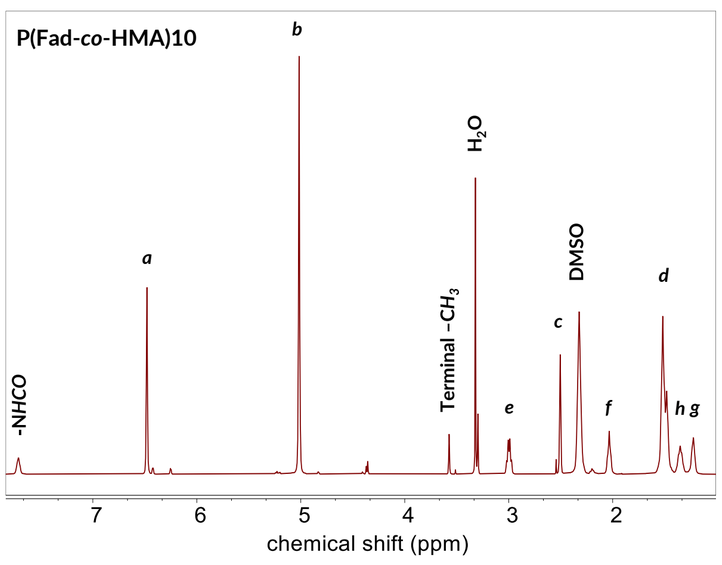
- ❑ solvent-free reaction
- ❑ milder reaction conditions
- ❑ easy recovery of the catalyst

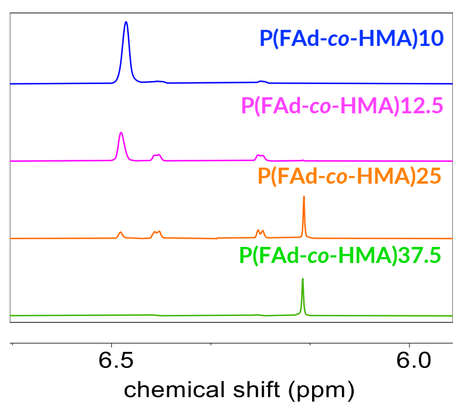
→ **Bio-based poly(ester amide)s**

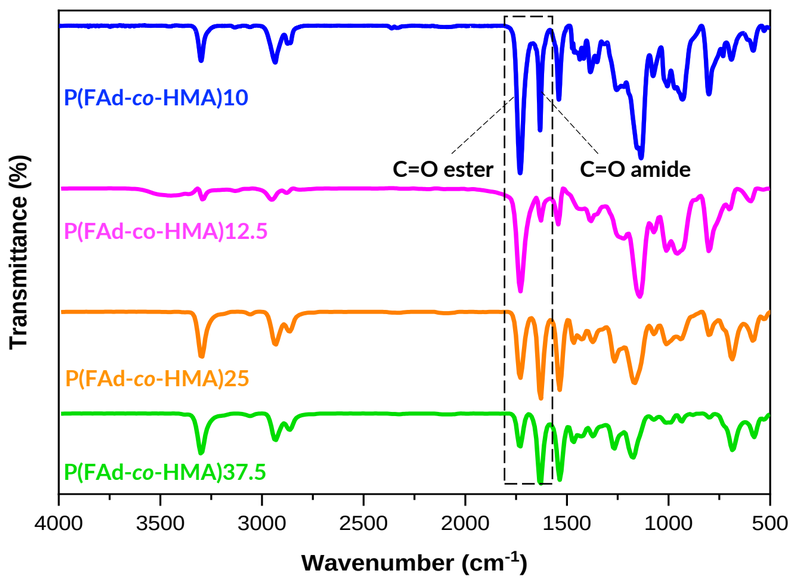
RESULTS

Structural Analysis



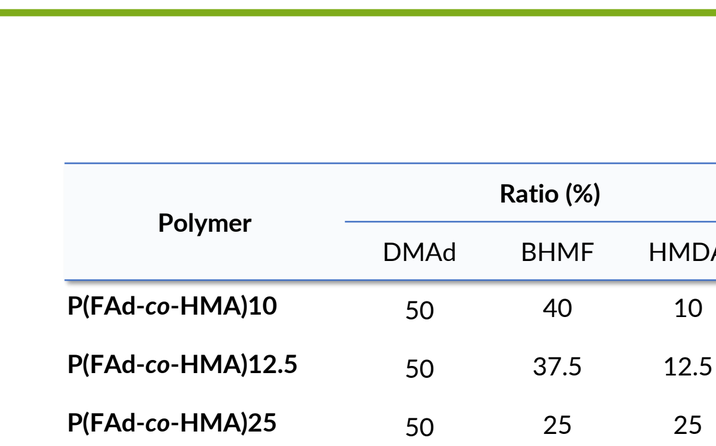


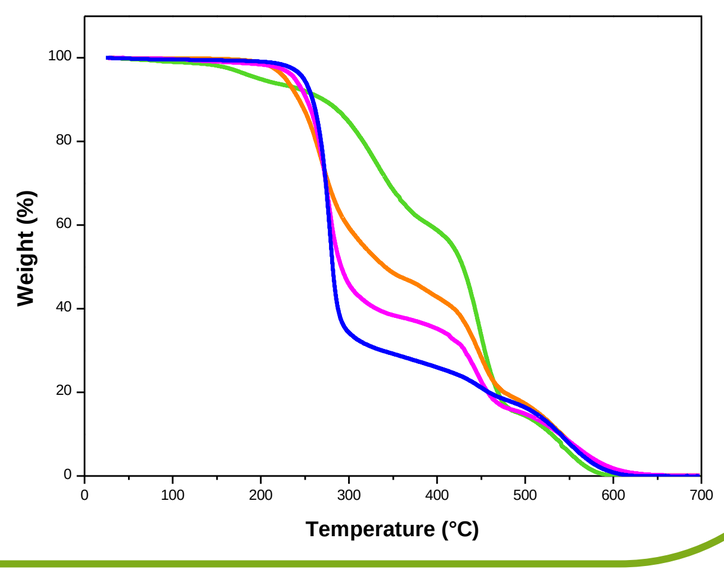




Polymer	BHMF conv. (%)	Ratio (%)	
		ester	amide
P(FAd-*co*-HMA)10	94.3	80.6	19.4
P(FAd-*co*-HMA)12.5	59.8	64.5	35.5
P(FAd-*co*-HMA)25	50.8	34	66
P(FAd-*co*-HMA)37.5	7.4	8.7	91.3

Thermal Analysis





CONCLUSIONS

- ❑ Biobased poly(ester amide)s were **successfully synthesized** via enzymatic polymerization using different monomer ratios.
- ❑ Reducing the HMDA content from 37.5% to 10% led to a significant **improvement in BHMF conversion**.
- ❑ The synthesized polymers exhibited **low glass transition temperatures** (-28°C < T_g < -17°C) and relatively **high melting temperatures** (84°C < T_m< 100°C).
- ❑ TGA revealed **good thermal stability in air**, with initial degradation temperature at around 270 °C.

OUTLOOK

- ❑ **Further characterizations**, including GPC, UV degradation studies, and mechanical tests, will be performed to evaluate and identify the most promising polymers for solar cell encapsulation.
- ❑ Future work will also focus on **optimizing polymer** architecture and processing parameters to enhance thermal, mechanical, and environmental performance.

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