Polyphosphoester-based Copolymers as Emulsion-Templated Polymerization Stabilizers towards Fully Degradable Scaffolds

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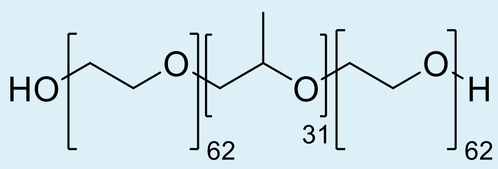
INTRODUCTION

Tissue engineering (TE) is an emerging approach focused on regenerating damaged tissues using biomaterial scaffolds with key features: degradability, biocompatibility, mechanical strength, and porosity.[1,2] Adequate porosity, essential for cell colonization, can be achieved through the high internal phase emulsion (HIPE) polymerization, an increasingly popular method for scaffold design. Moreover, polyphosphoesters (PPE) are promising for TE due to their tunable hydrophilicity and degradability via their pendant group adjustment.[3] In this context, our work aims at developing novel degradable **amphiphilic PPE-based triblock** (**PMBM**, **PMBM-DMA**) copolymers as an alternative to traditional non-degradable surfactants for stabilizing HIPEs, producing **fully degradable PPE-based porous scaffolds,** and exploring their potential for TE.

Classical surfactant: Pluronic ® F-68



PPE SYNTHESIS

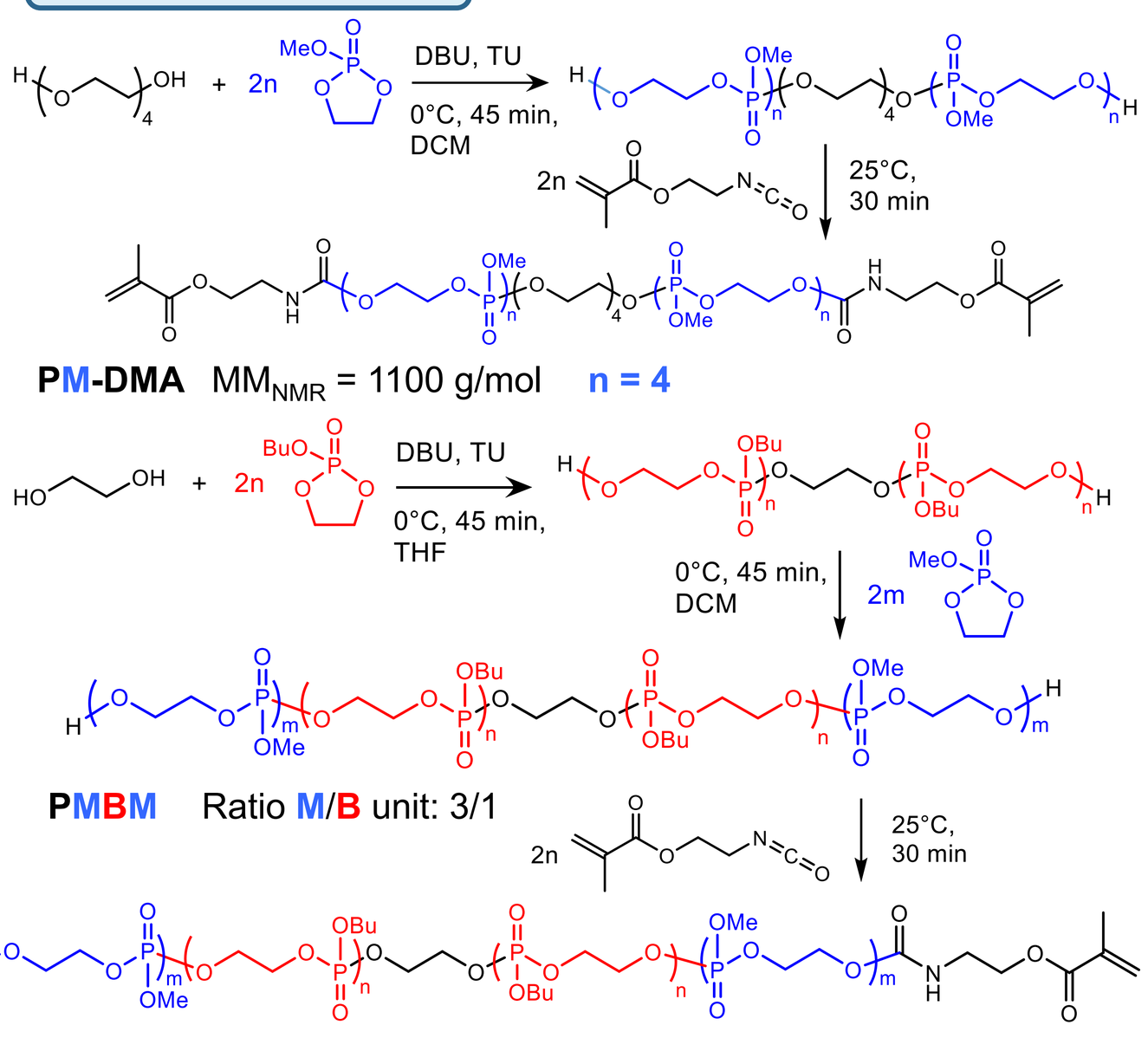


Fig 1: Synthesis steps of **PM-DMA**, as well as **PMBM** and **PMBM-DMA** mimicking the structure of F-68.

SURFACE TENSION

Table 1: Surface properties at the water/air interface at 25 °C.

	F-68	F-68-DMA	PMBM	PMBM-DMA
CMC* [g/L]	0.16	0.24	0.09	0.07
Surface tension at CMC [mN/M]	52.8	51.3	37.3	31.4

* CMC: critical micellization concentration

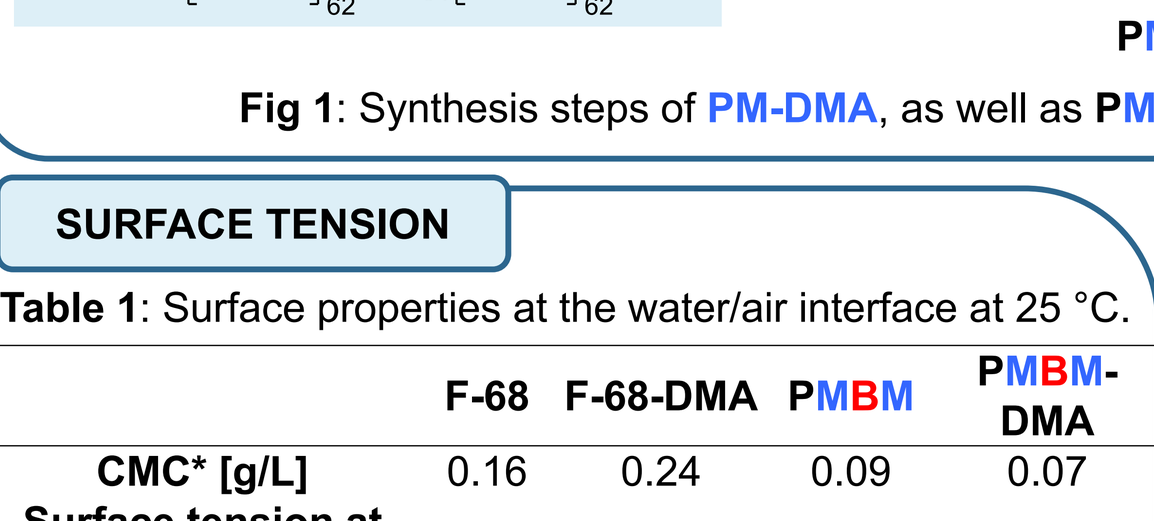


Fig 2: Surface tension at equilibrium versus surfactant concentration.

MORPHOLOGY

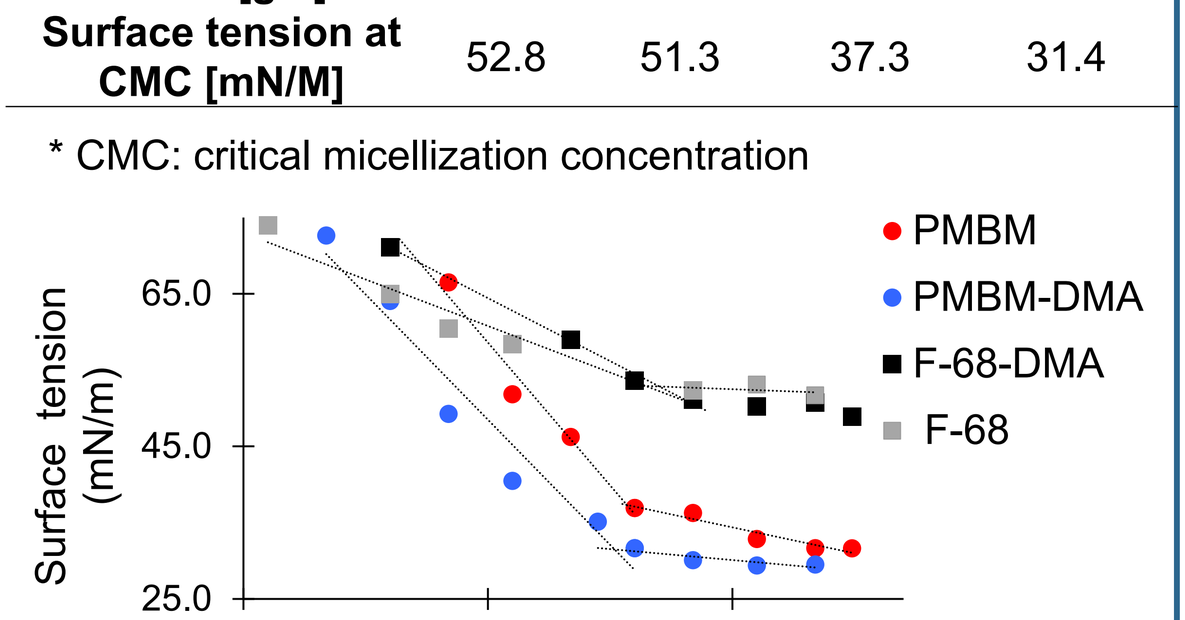


Fig 4: SEM images of polyHIPEs

SCAFFOLDS FORMULATION & CHARACTERISTICS

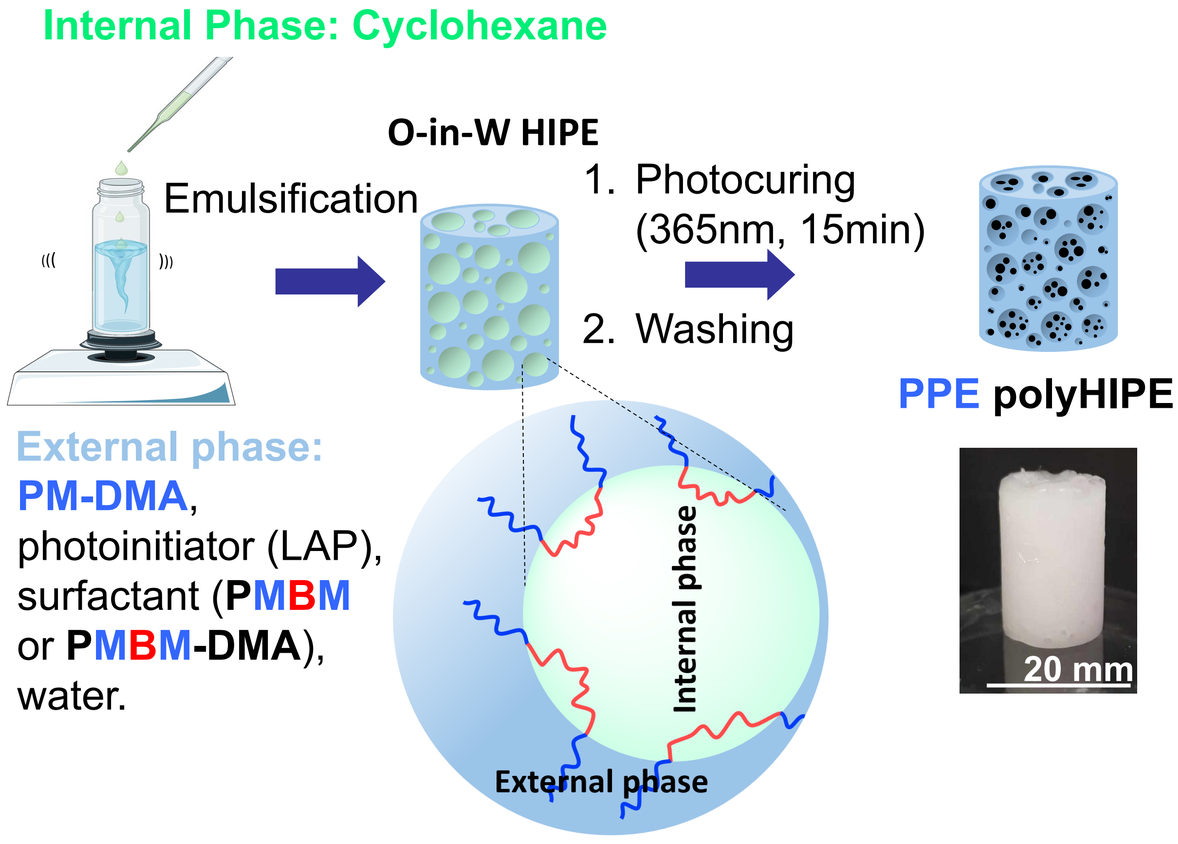


Fig 3: Main steps of polyHIPE synthesis

Table 4: Formulation of polyHIPEs.

samples[a]	PM-DMA (wt%)	PMBM (wt%)	PMBM-DMA (wt%)	E (kPa)[b]
PH1	50	5	-	12.7 ± 3.67
PH2	50	10	-	13.52 ± 4.10
PH3	50	-	2.5	32.01 ± 4.18
PH4	50	-	5	57.42 ± 4.80
PH5	50	-	10	89.08 ± 6.98
PH6	-	-	50	5.57 ± 1.46

[a]External phase: PM-DMA (50 wt%*); surfactant at different wt%*; LAP(0.01 wt%*) (*compared to aqueous phase); internal phase: cyclohexane; O/W = 85/15. [b]E = Young modulus.

CONCLUSION

- Successful synthesis of fully PPE-based scaffolds
- Mechanical properties suitable for soft tissues

PERSPECTIVES

- Investigate a matrix made of 25/25 **PM-DMA**/**PMBM-DMA**
- Evaluate the impact of the hydrophobic PPE block at the interface on cell adhesion
- Evaluate the potential of scaffolds through biological testing.

REFERENCES

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[2] Yadav, P et al *Mater. Today Proc.* **2021**, *44*, 2623–2628.
[3] Rheinberger, T et al *Eur. Polym. J.* **2023**, *200,* 112464.

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