EMULSION TEMPLATED POLYPHOSPHOESTER-BASED SCAFFOLDS FOR TISSUE ENGINEERING

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BACKGROUND

Nowadays, **porous scaffolds** made of biodegradable polymers have gained a lot of interest and are extensively used in tissue engineering. There is already a lot of biocompatible scaffolds with suitable parameters like **mechanical properties** and **adhesion motifs**, but the search for innovative scaffolds with **tunable hydrophilicity** and **degradability** is still relevant. In addition, **emulsion templating polymerization** is particularly attractive for preparing macroporous materials with **tunable pore sizes** such as **H**igh **I**nternal **P**hase **E**mulsion (**HIPE**).[1,2,3]

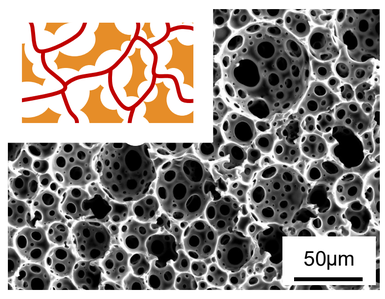
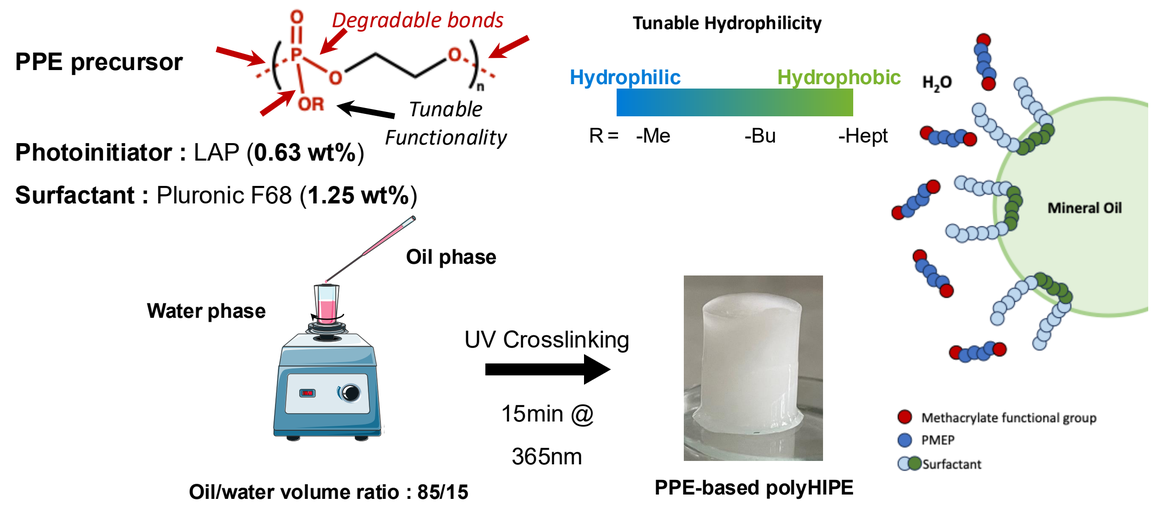


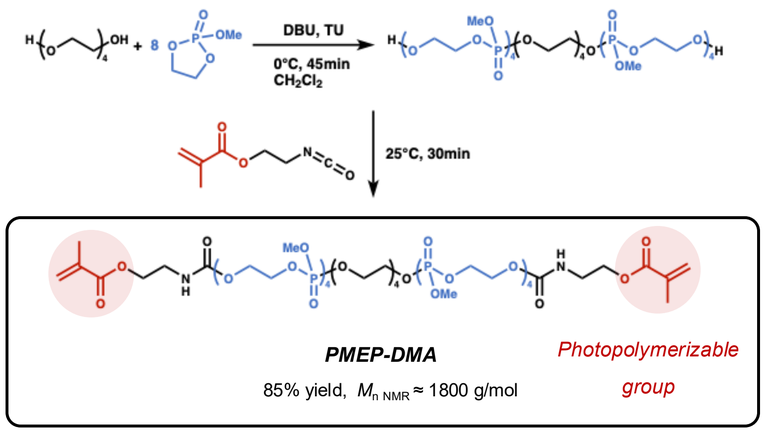
Fig. 1: SEM image of a polyHIPE (PPE) scaffold and representation of its high interconnectivity providing enhanced permeability and cell penetration

STRATEGY



RESULTS

Synthesis of PPE precursor



Emulsion templating polymerization

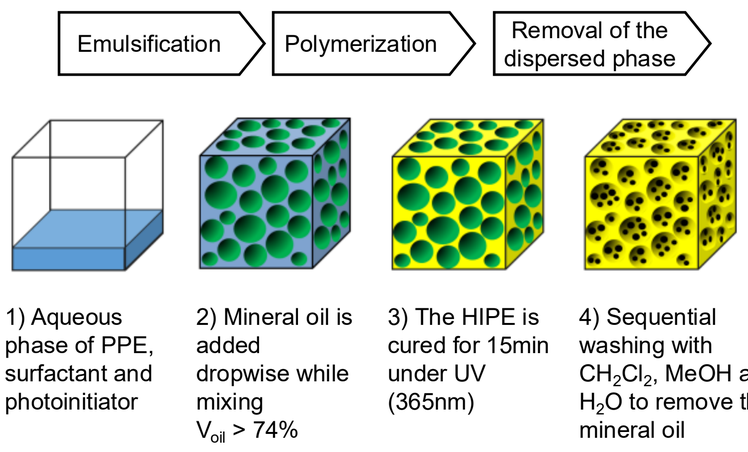


Fig. 4: Main steps of polyHIPE formation

Table 1: PPE polyHIPE formulations

Entry	Samples	Surfactant (wt%)[a]	O/W (v/v)[b]	D (µm)[c]	d (µm)[d]	DOO [e]	E (kPa)[f]
1	PH_1	10	85/15	16.3 ± 7.0	2.4 ± 0.8	0.19	10.6 ± 1.1
2	PH_2	5	85/15	16.7 ± 5.9	3.1 ± 1.2	0.29	9.3 ± 3.4
3	PH_3	1.25	85/15	18.1 ± 4.9	3.6 ± 1.0	0.32	11.3 ± 3.1
4	PH_4	1.25	75/25	20.4 ± 3.8	3.6 ± 1.0	0.16	42.3 ± 0.4
5	PH_5	1.25	80/20	18.8 ± 4.5	3.4 ± 1.0	0.26	33.6 ± 3.3
6	PH_6	1.25	90/10	18.1 ± 4.9	3.8 ± 1.1	0.36	3.3 ± 0.4

Conditions: external phase = mineral oil, PM-DMA (50 wt% compared to aqueous phase), LAP (1.33 wt% compared to the aqueous phase), photocuring (15 min, λ=365 nm). [a] Surfactant = F-68 (wt% compared to the aqueous phase). [b] volume ratios between internal oil phase and external aqueous phase. [c] Mean pore diameter. [d] Mean window diameter. [e] Degree of openness. [f] Young Modulus measured by compression tests.

Characterization of PPE polyHIPEs

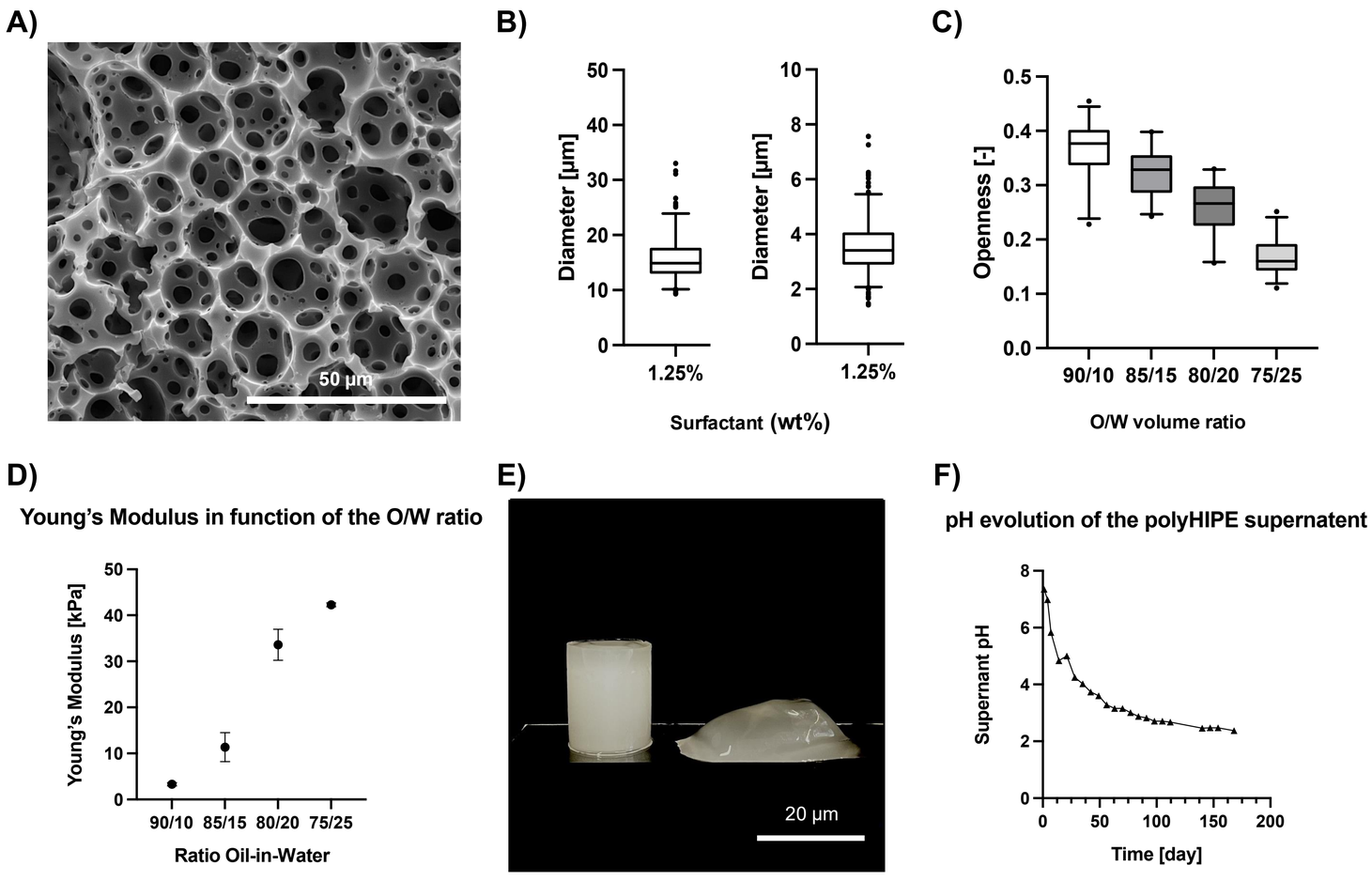


Fig. 6: A) SEM image of PH_3 sample. B) Diameter and window diameter of PH_3. C) Openness of polyHIPEs with different O/W ratio. D) Young's modulus of polyHIPE formulation with different O/W ratio. E) PolyHIPE scaffold after unmolding (left) and after 7 days in pH = 10.6 buffer (right). F) Evolution of the water pH over time to assess the degradability of the PPE polyHIPE.

Biological properties of PPE polyHIPEs

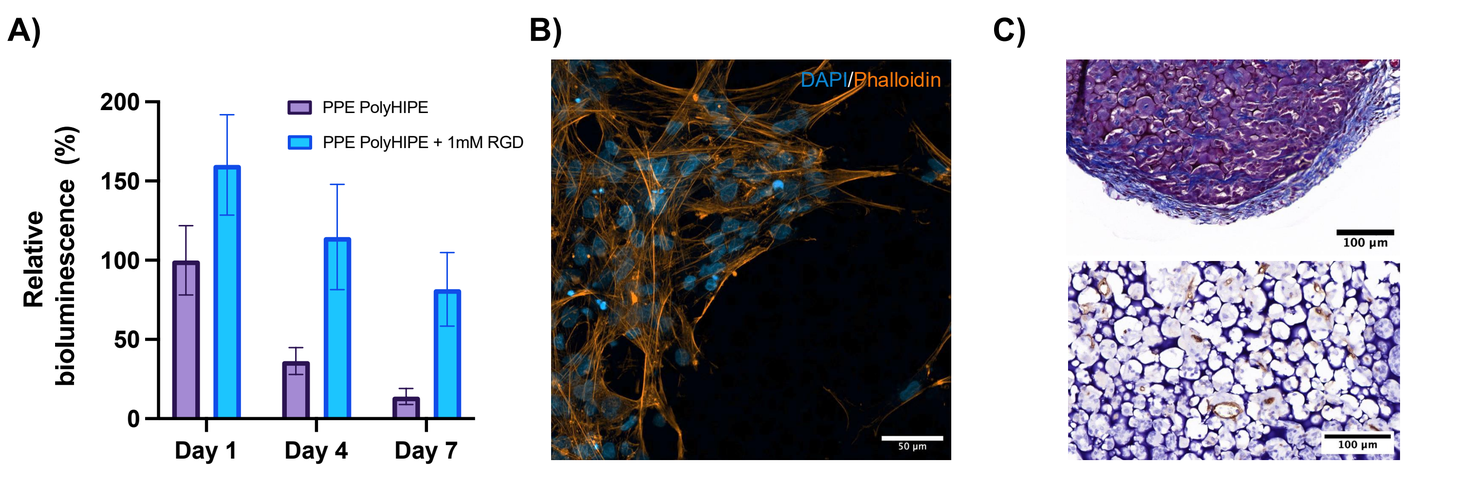


Fig. 6: A) Bioluminescence assay to measure the cell viability of polyHIPE scaffold with and without RGD peptide (n=3 and N=4). B) Confocal image of PPE polyHIPE modified with RGD peptide after 1 day. Nuclei are stained in blue (DAPI) and actin filaments are stained in orange (Phalloidin). C) Masson Trichrome staining (top) and CD-31 staining (bottom) after 4 weeks subcutaneous implantation in mices.

Conclusion

- ✓ **Successful** preparation and characterization of degradable **PPE polyHIPE scaffold**
- ✓ Adequate mechanical and morphological properties of our scaffolds
- ✓ Assessments of **in vitro** and **in vivo biocompatibility** of the scaffolds
- ✓ **In vivo characterization** after 1 week and 4 weeks **implantation**

Perspectives

- ➢ Synthesis of a **PPE triblock copolymer** to **graft hydrophobic region** on the **surface** of the scaffold
- ➢ Asses the **impact** of hydrophobic region on the **cellular adhesion**
- ➢ **In vivo degradation** and longer implantation time

Day 7 of culture on a hydrophobic PPE scaffold

References

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