Editorial corner – a personal view

Hype about High Internal Phase Emulsion templating:

Adding particles makes all the difference

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High porosity, interconnected porous polymers are attractive materials for numerous applications from supports for cell cultures, solid-state chemistry and setting retarded cements. Macroporous polymers can be prepared by various methods, such as chemical and physical blowing, but also by emulsion templating; first reported by von Bonin and Bartl in 1962 (DOI: [10.1002/macp.1962.020570105](https://doi.org/10.1002/macp.1962.020570105)), emulsion templating has now emerged as effective method to synthesise porous polymers with tailored pore morphology and physical properties. High or Medium Internal Phase Emulsions (H/MIPES) with a continuous phase consisting of or containing monomers are used as templates for the preparation of interconnected macroporous polymers, called poly(merised)M/HIPES. PolyH/MIPES are synthesised from emulsion templates stabilised by large amounts of surfactants. The resulting polymers are interconnected and have porosities of up to 99%. However, applications of polyHIPEs remain limited mainly because of their poor mechanical properties but also their low permeability. In the last decade much research focused on improving the mechanical properties, which was achieved by incorporating reinforcements, increasing the foam density or by using different monomers and polymerisation routes. Improving the permeability of porous polymers while maintaining sufficient mechanical properties was more challenging; increasing the porosity of interconnected porous polymers results in higher permeability but lower mechanical properties. Maximum pore throat sizes of polyM/HIPES produced from surfactant stabilised emulsion templates are limited, which also limits the permeability.

We introduced a new class of porous polymers called poly-Pickering-M/HIPES, produced from particle stabilised (Pickering) M/HIPES. These porous polymers have pore sizes of up to 1.5 mm and porosities of up to 90% (DOI: [10.1039/B708935J](https://doi.org/10.1039/B708935J)) but are typically closed-cell. However, this new class of polyHIPEs with large pores should allow for very permeable polyHIPEs if the pores could be made interconnected. This was possible by introducing a surfactant to pre-made Pickering emulsion templates (DOI: [10.1002/adma.201000729](https://doi.org/10.1002/adma.201000729)). The resulting open-porous poly-Pickering-HIPES had a maximum gas permeability of 2.6 Darcy. Alternatively, if particles and surfactant were simultaneously used as emulsifiers, porous polymers with a hierarchical pore structure with enhanced mechanical properties and high permeability were produced (DOI: [10.1002/marc.201100382](https://doi.org/10.1002/marc.201100382)).

Now that we have a tool kit for new polyM/HIPE architectures, we believe that this can be combined with different polymer chemistries to produce a whole raft of novel interconnected porous polymers. By selecting appropriate particulate emulsifiers we could create functional porous polymers, which by virtue of the liquid template can be given any shape making this a versatile approach for the future.

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