*Electronic Supplementary Information (ESI)*

# Closed-cell and open-cell porous polymers from ionomer-stabilized high internal phase emulsions

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## 1. Recipes of HIPEs

**Table S1**: Recipes for BA-HIPE-Y

| | BA-HIPE-75 | BA-HIPE-80 | BA-HIPE-83 |
|---|---|---|---|
| Organic continuous phase (v/v %) | | | |
| Butyl acrylate (BA) | 22 | 17.6 | 15.4 |
| SPS solution (10 w/v % in THF) | 0.5 | 0.4 | 0.35 |
| Ethylene glycol dimethacrylate | 1 | 0.8 | 0.7 |
| AIBN solution (0.2 M in toluene) | 1.5 | 1.2 | 1.05 |
| Total | 25 | 20 | 17.5 |
| Aqueous dispersed phase (v/v%) | | | |
| Aqueous NaCl solution (0.3 M) | 75 | 80 | 83 |
| SPS in the continuous phase | 0.2 | 0.2 | 0.2 |

**Table S2**: Recipes for St-HIPE-Y

| | St-HIPE-75 | St-HIPE-80 | St-HIPE-83 |
|---|---|---|---|
| Organic continuous phase (v/v %) | | | |
| Styrene (St) | 22 | 17.6 | 15.4 |
| SPS solution (10 w/v % in THF) | 0.5 | 0.4 | 0.35 |
| Ethylene glycol dimethacrylate | 1 | 0.8 | 0.7 |
| AIBN solution (0.2 M in toluene) | 1.5 | 1.2 | 1.05 |
| Total | 25 | 20 | 17.5 |
| Aqueous dispersed phase (v/v%) | | | |
| Aqueous NaCl solution (0.3 M) | 75 | 80 | 83 |
| SPS in the continuous phase | 0.2 | 0.2 | 0.2 |

**Table S3**: Recipes for St-HIPE-75 with 0.2, 0.8 and 1.5 % of SPS

| | St-HIPE-75 | St-HIPE-75 | St-HIPE-75 |
|---|---|---|---|
| Organic continuous phase (v/v %) | | | |
| Styrene (St) | 22 | 20.5 | 19.05 |
| SPS solution (10 w/v % in THF) | 0.5 | 2 | 3.75 |
| Ethylene glycol dimethacrylate | 1 | 1 | 0.9 |
| AIBN solution (0.2 M in toluene) | 1.5 | 1.5 | 1.3 |
| Total | 25 | 25 | 25 |
| Aqueous dispersed phase (v/v%) | | | |
| Aqueous NaCl solution (0.3 M) | 75 | 75 | 75 |
| SPS in the continuous phase | 0.2 | 0.8 | 1.5 |

## 2. Photo of mixture

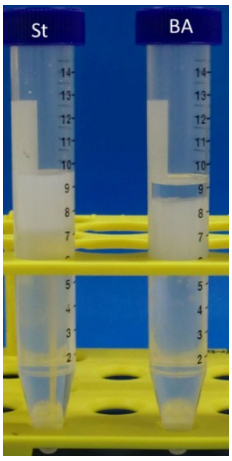


**Fig. S1** Photos of mixtures consisting of the aqueous phase and styrene (St) or butyl acrylate (BA) after a gentle shake.

## 3. Rheological measurements

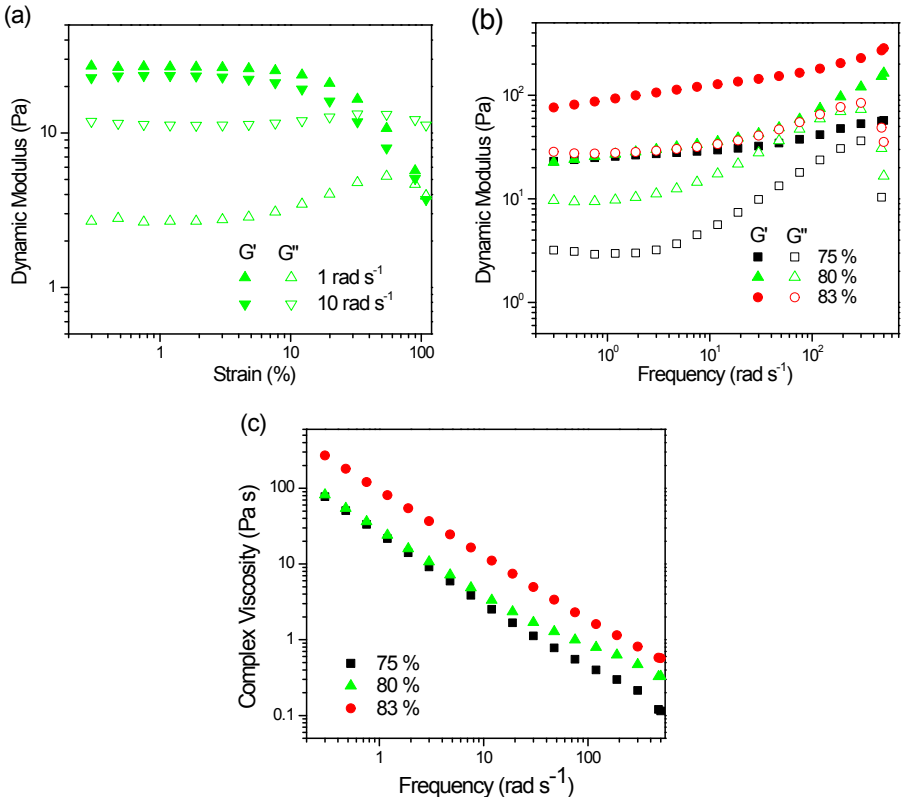


**Fig.S2** Dynamic moduli G' and G'' for (a) HIPE with 80 % of the dispersed phase as a function of strain; (b) HIPEs with 75 %, 80 % and 83 % of the dispersed phase as a function of oscillatory shear frequency; and (c) complex viscosity of HIPEs with 75 %, 80 % and 83 % of the dispersed phase as a function of oscillatory shear frequency. The NaCl concentration in the dispersed aqueous phase is 0.3 M and the organic phase is toluene.

Toluene instead of styrene was used to form HIPEs for rheological measurements, because styrene is smell and is not allowed for such tests. The ionomer concentration and volume fraction of the dispersed phase were kept same as the corresponding St-HIPEs. Rheological experiments were conducted with a TA DHR 3 rheometer using plate geometry at room temperature. The plate geometry has a diameter of 40 mm and the gap was set at 500 μm. A solvent trap was applied to diminish the evaporation of solvents. Dynamic strain sweeps were conducted from 0.3 to 300 % at 1 and 10 rad $s^{-1}$, and the frequency sweeps were performed at a strain of 1% with an angular frequency from 0.3 to 500 rad $s^{-1}$.

It can be seen from Fig. S2b that G' is higher than the corresponding G'' of HIPEs, showing the formation of three-dimensional network. The formation of network indicates the high viscosity of HIPEs. Fig. S2c shows that the complex viscosities of HIPEs increase with the volume fractions of the dispersed phase.

**4. $^1$H NMR of solvent residuum**

After the Soxhlet extraction of BA-polyHIPEs, the solvent residuum was collected and the chemical compositions of the residuum were verified by $^1$H-NMR. The $^1$H-NMR spectra of SPS and solvent residuum are listed in Fig. S3a and S3b, respectively. The peaks at 6.59, 7.09 and 8.41 ppm in Fig. S3a are ascribed to Ar–H of SPS.[1] No such peaks can be observed in Fig. S3b, showing that there is no SPS in the solvent residuum. The residuum consists of PBA (from peaks at 0.88, 1.31, 1.55, 2.22 and 4.00 ppm)[2] and THF (from peaks at 1.80 and 3.69 ppm).[3]

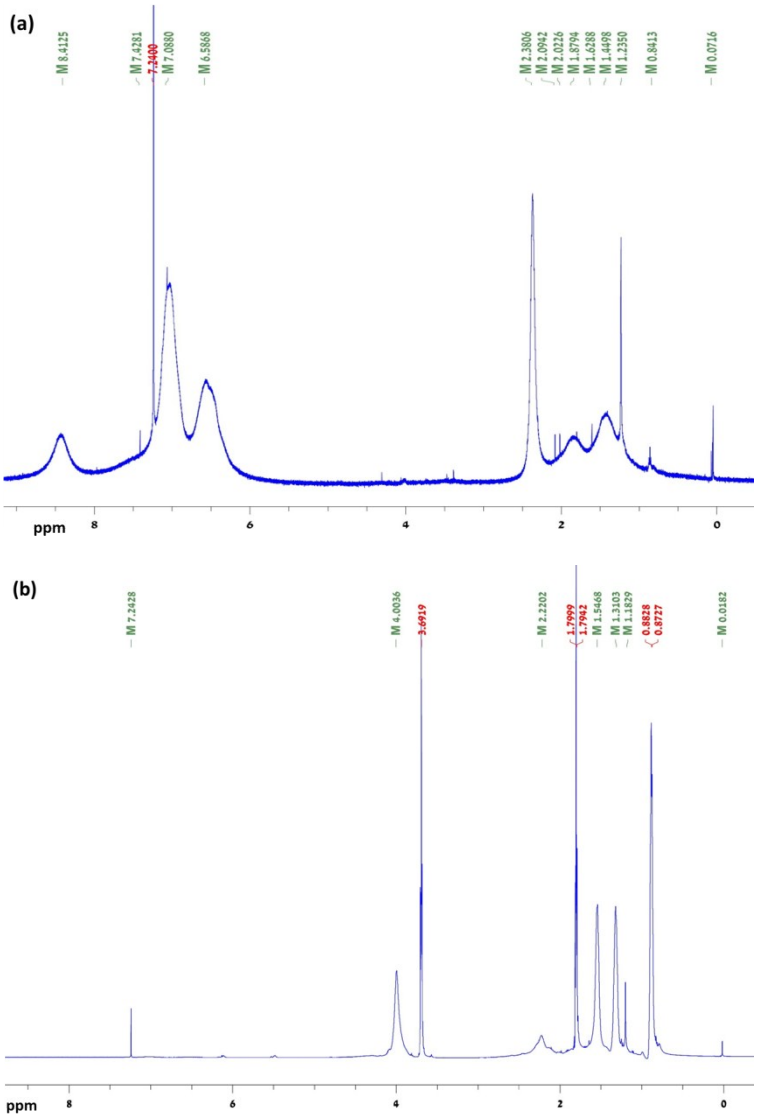


**Fig. S3** $^{1}$H-NMR spectra of (a) SPS and (b) solvent residuum in $CDCl_3$.

## 5. References


1. J. C. Yang, M. J. Jablonsky and J. W. Mays, *Polymer*, 2002, **43**, 5125.
2. M. Zhang, T. Breiner, H. Mori and A. H. E. Müller, *Polymer*, 2003, **44**, 1449.
3. H. E. Gottlieb, V. Kotlyar and A. Nudelman, *J. Org. Chem.*, 1997, **62**, 7512.