Flowing liquids through Fluid-Bicontinuous Gels

Mohd A. Khan, Alessio J. Sprockel, Katherine A. Macmillan, Jesse Steenhoff, Shankar P. Kharal, Stephen Boakye-Ansah, Meyer T. Alting, Martin F. Haase

[a] Van't Hoff Laboratory for Physical and Colloid Chemistry, Department of Chemistry, Debye Institute of Nanomaterials Science, Utrecht University; Utrecht, 3584 CH, The Netherlands

Fluid-bicontinuous gels (bijels) are a recent class of soft materials that allow two immiscible fluids to interact within a porous solid.[1,2] Current limitations for their applications are the limited control over their non-equilibrium assembly process, and the inability to flow liquids through them.[2,3] Here, we develop a scalable synthesis route to obtain bijels with high specific surface areas of up to 2 m^2/cm^3. Moreover, we show that electroosmosis can be employed to pump liquids through the bijels. Furthermore, we investigate liquid-liquid extraction by combining mechanical and electroosmotic pumping through the bijel. The high surface areas of the bijels obtained here, and the liquid flow enhance the potentials of bijels as highly permeable porous materials with applications as microreaction media, fuel-cell components, and separation membranes.

[1] Stratford, K., Adhikari, R., Pagonabarraga, I., Desplat, J. C., & Cates, M. E. (2005). Colloidal jamming at interfaces: A route to fluid-bicontinuous gels. Science, 309(5744), 2198-2201.
[2] Haase, M. F., Stebe, K. J., & Lee, D. (2015). Continuous fabrication of hierarchical and asymmetric bijel microparticles, fibers, and membranes by solvent transfer-induced phase separation (STRIPS). Advanced Materials, 27(44), 7065-7071.
[3] Haase, M. F., Jeon, H., Hough, N., Kim, J. H., Stebe, K. J., & Lee, D. (2017). Multifunctional nanocomposite hollow fiber membranes by solvent transfer induced phase separation. Nature communications, 8(1), 1-7.
[4] Kharal, S. P., & Haase, M. F. (2022). Centrifugal Assembly of Helical Bijel Fibers for pH Responsive Composite Hydrogels. *Small*, 2106826.