Post-processing bijels: all binary fluids are not born equal

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The liquid-liquid phase separation of binary fluids, induced by a temperature quench, can be arrested by colloidal particles trapped at the interface. The arrested structure, a novel soft solid known as a bicontinuous interfacially-jammed emulsion gel (bijel), was first predicted by computer simulations and subsequently realised in the lab [1]. Initially the mechanical properties are controlled by the interfacial tension between the two fluid domains (e.g. a deeper quench yields a stronger bijel) and the volume fraction of particles [2]. Reversing the temperature quench results in the two fluids becoming miscible again. Whether or not this leaves a colloidal gel in place which is stable without a liquid-liquid interface (a “monogel”) depends on the age of the gel [3] and the choice of liquids [4]. The ease of post processing a bijel for use in materials applications (electrodes, catalyst supports etc) appears to depend entirely on this difference [2]. A consideration of the role of both the interfacial tension and the interparticle interactions is required to explain our observations.

[1] Stratford et al. Science **309**, 2198 (2005); Herzig et al. Nat. Mater. **6**, 966 (2007).
[2] Lee et al. Adv. Funct. Mater. **23**, 417 (2013).
[3] Sanz et al. Phys. Rev. Lett. **103**, 255502 (2009).
[4] Tavacoli et al. Adv. Funct. Mater. **21**, 2020 (2011).