

# Building and Burning Bridges: An emulsion-based design motif for energy materials

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One of the main limitations affecting energy storage systems such as batteries and fuel cells is that they have a limited energy density. Some systems, such as Lithium-air batteries, have been developed in order to improve this by drastically reducing the mass of the battery, but these technologies are limited by their rapid loss of capacity over a number of charge/discharge cycles. To avoid this problem, alternative electrode morphologies need to be considered.

Soft materials, such as emulsions, are a good candidate for alternative electrode materials, because they offer a very straightforward way to create a tortuous bicontinuous structure. These structures have two separate, but interweaved, continuous channels, which can be functionalised as a current collector channel and a fuel/electrolyte channel. The benefit of such structures is that it is more difficult for reaction products to block up the electrode, which is a major cause of charge-cycle capacity loss. Here we consider a particle stabilised high internal phase emulsion as a basis for such a structure, as seen in figures 1 & 2. We use sacrificial bridging particles to make holes between adjacent droplets, creating a continuous internal fluid channel.

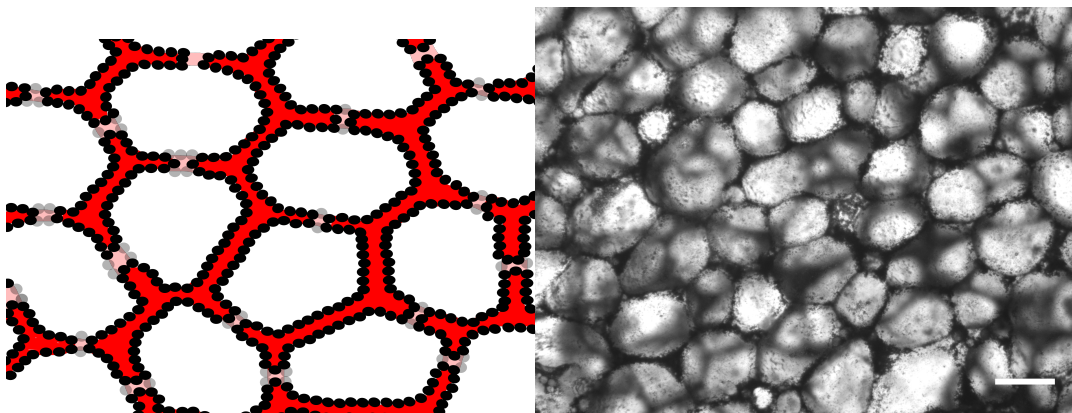


Fig. 1: Proposed electrode structure based on high internal phase emulsion.

Fig. 2: High internal phase emulsion stabilised with YSZ, a fuel cell material.