# Tuning Bijel Channel Permeability Through Silica Deposition for Particle Infiltration Purposes

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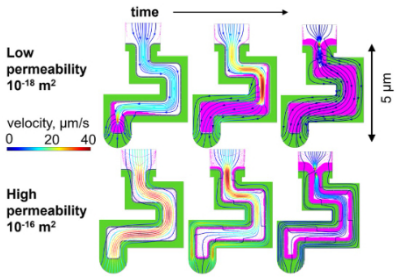
Bicontinuous interfacially-jammed emulsion gels (bijels) consist of two immiscible phases, typically oil and water, that form continuous, interwoven networks, stabilized at the interface by nanoparticles. Due to the interwoven nature of their networks, bijels boast large interfacial areas per volume, making them attractive for energy storage applications [1]. In this research, we will utilize the two networks of the bijel to create the cathode and anode of a lithium-ion battery, facilitating higher power delivery and faster charging due to the reduced diffusion length of the lithium ions. In order to create the cathode, the oil channel of the bijel will be infiltrated with colloidal lithium iron phosphate (LFP) nanoparticles. However, simulations show that, if the permeability of the water channel is sufficiently high, the LFP colloidal suspension will penetrate into the water channel, thereby depositing the nanoparticles on the network walls, leading to clogging of the channel before it can be adequately filled. Therefore, in order to ensure proper infiltration, the permeability of the water channel must be reduced. This will be achieved by introducing tetramethyl orthosilicate (TMOS) into the water channel. Upon contact with water, TMOS hydrolyzes to silica which deposits onto the anode nanoparticles in the water network, filling up voids in between the particles, thereby reducing the permeability of the channel [2]. Through a combination of confocal laser scanning microscopy, scanning electron microscopy, and pressure gradient measurements, the influence of the TMOS treatment can be studied. Based on these results, adjustments in TMOS concentration and reaction time facilitate control over the bijel channel permeability.

**Keywords:**
Bijel, Battery, Permeability




*Snapshots of fluid dynamics simulations showing the change in particle depositing behavior for different bijel channel permeabilities.*

**References:**

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