Fracture properties of colloidal suspensions

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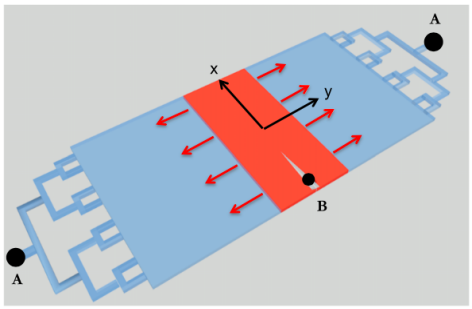

Experimental setup

Charged colloidal particles, such as nanosilica and clay minerals, when immersed in salt solutions, interact electrostatically to produce structures ranging from solid aggregates to isotropic and nematic gels as a function of concentration, ionic strength, aggregation time and the nature of the particles themselves [1-2]. The study of the fracture behavior of gel structures is complicated by the experimental challenges of gripping and macroscopic flow and the complex interplay of large deformations and viscoelastic processes [3].

In this work, we use an experimental setup previously developed for the study of biopolymer gels [4] to investigate the mechanical response of aqueous colloidal silica suspension *Ludox TM-50* and synthetic hectorite clay *Laponite RD* gels. The device consists of a rigid chamber fabricated using microfluidic stickers technology (Figure). It is first filled with FC3283 fluorinated oil and then injected with the gels while they are still fluid. By sucking the oil out of the chamber, a displacement velocity proportional to the the oil flow rate is imposed to the oil-gel interfaces. The deformation results in a single mode I crack nucleated from a built-in notch.

The crack opening displacement is obtained from the shape of the crack in the tip vicinity, while the displacement field is determined using Digital Image Correlation. In this plane stress configuration, it allows for the determination of the stress intensity factor and the energy release rate. By comparing the results of cracks with various propagation velocities, we can observe departures from Linear Elastic Fracture Mechanics and have insight into the dissipative mechanisms and crack behavior of different silica nanoparticle and clay gels.

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