Controlling foam stability with an electric field: thermal effects.

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ABSTRACT

In many applications, it is required to control the lifetime of a foam by limiting the drainage or triggering the collapse at a specific location or a given time. We show here experimentally that this can be achieved by applying an external electric field at the edge of the foam. Depending on the applied voltage, it controls either gravity driven drainage, the foam stability, or the foam collapse at a specific location. The electric field has indeed two effects. It first induces a motion of the liquid due to classical electroosmosis, that could only qualitatively explain the observations. But it also induces thermal heating due to Joule effect, and results in thermal gradients that we characterize experimentally. A full quantitative description is then achieved by a simple model taking into account both the electroosmotic transport in the liquid foam and the thermal Marangoni flows.

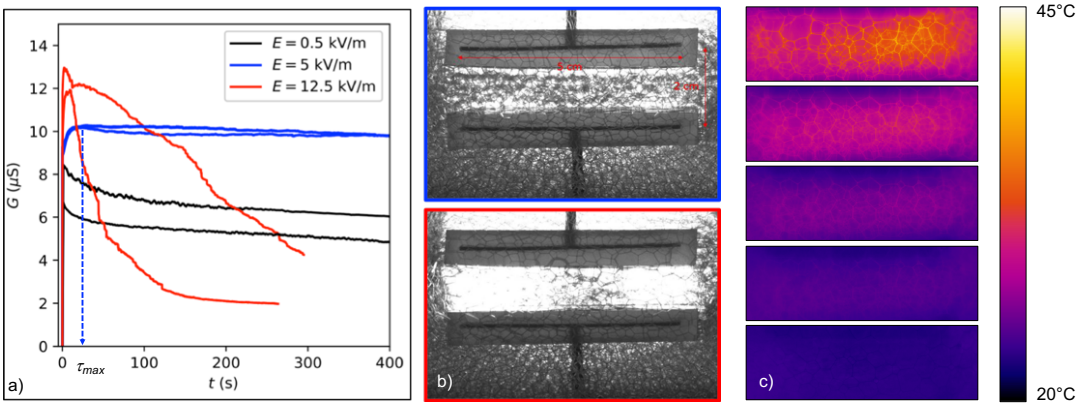

Figure 1: a): Conductance G of the foam as a function of time for different applied electric fields. R=4.3mm, ϕ_i=0.26%, L=20mm. b) Snapshots of foam for ΔV=100V (top) and ΔV=500V (bottom), R=2.6mm, ϕ_i=0.47%, L=20mm. c) Infrared camera images of the foam for different applied voltages (from bottom to top: 200V, 400V, 600V, 800V, 1000V). R= 3.7mm, ϕ_i=0.11%, L=29mm. Image height corresponds to 22.6mm.