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Improved theory on AC electrothermal flows SOPHIE LOIRE, PAUL KAUFFMANN, IGOR MEZIC, UCSB — We compare simulations from new theory to experimental measurements on AC eletrothermal flows (ACET) for micromixing application on 96 microwell (10 μL) plate for high conductivity physiological solutions. This application leads to certain design constraints (electrode sizes, voltage range, conductivity). Beneath each microwell filled with saline solution (σ=0.02 mS/cm, to 16 mS/cm.), a sinusoidal voltage (0 to 40Vpp, 1MHz) is applied between 3 interdigitated gold electrodes 35 μm thick, separated by a 150μm gap. Due to this design, the ACET flows, measured by μPIV, doesn't follow the present theory. Similarly to natural convection, a bifurcation like behaviour is observed : the flows appear only above a critical voltage. The velocities scale as V^p with $p \geq 4$ with p increasing with conductivities. We analyse the validity conditions of the weak temperature gradient approximations. Accordingly we propose a thermal-electrical strong coupling model, which is traditionally neglected. We also study the competition between ACET and natural convection appearing in this configuration.

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