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Droplets break-up in junctions with and without electric field¹ LAURE MENETRIER, HERVE WILLAIME, PATRICK TABELING, Laboratoire Théorie et Microfluidique, UMR7083 ESPCI-CNRS Paris, DAN E. ANGELESCU, Schlumberger-Doll Research, Cambridge, MA — Experiments are performed on droplet break up in microfluidic junctions of arbitrary angles, with Capillary numbers below 10-2. By studying the droplet dynamics under various geometries and flow conditions, with different fluids, with and without electric field, we found the existence of two break-up regimes: direct break-up (the droplet invades the two branches of the junction before splitting up in two parts) and retarded break-up (a finger develops in the secondary branch, retreats and eventually breaks up). In all flow conditions, the diagram length of the finger velocity in the secondary channel represents well the conditions of existence of these regimes. It has the same structure, with and without an electric field, throughout the range of conditions we considered. Remarkably, direct break-up is controled by a critical length that depends exclusively on the geometry of the junction and the applied electric field. These characteristics are surprisingly well described at a semi quantitative level - by a theory assuming small capillary numbers. We succeeded in particular to describe the effect of the geometry and, at a more qualitative level, the influrence of the electric field on the breakup conditions.

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