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The size and shape of gas-focused viscous micro-jets C. FERRERA, University of Extremadura, A.M. GANAN-CALVO, University of Seville, J.M. MONTANERO, E.J. VEGA, University of Extremadura, M.A. HERRADA, University of Seville — The size and shape of gas-focused viscous micro-jets are analyzed theoretically and experimentally. These micro-jets are shaped by the action of a co-flowing gas stream due to both the pressure drop in the axial direction occurring in front of the discharge orifice, and the tangential viscous stress caused by the difference between the velocities of the gas and jet behind the orifice. The slender approximation is used to describing the shape of the tapering meniscus and the emitted liquid ligament. Assuming that the driving force takes a uniform value over the entire liquid domain, a universal (self-similar) solution of the momentum equation can be obtained. Experiments were conducted to assess the validity of that solution for a wide range of liquid viscosities. A remarkable collapse into a single curve is obtained for of all jet diameters measured beyond the orifice. This result shows that the driving force mentioned above attains a rather homogeneous value at the region where the micro-jet develops. The universal solution also provides satisfactory results in front of the orifice for sufficiently slender liquid meniscus, provided that the ratio capillary-to-orifice distance to orifice diameter takes sufficiently small values. The approach used in this work can also be applied to study other microjet generation means (co-flowing, electrospray, electrospinning…).

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