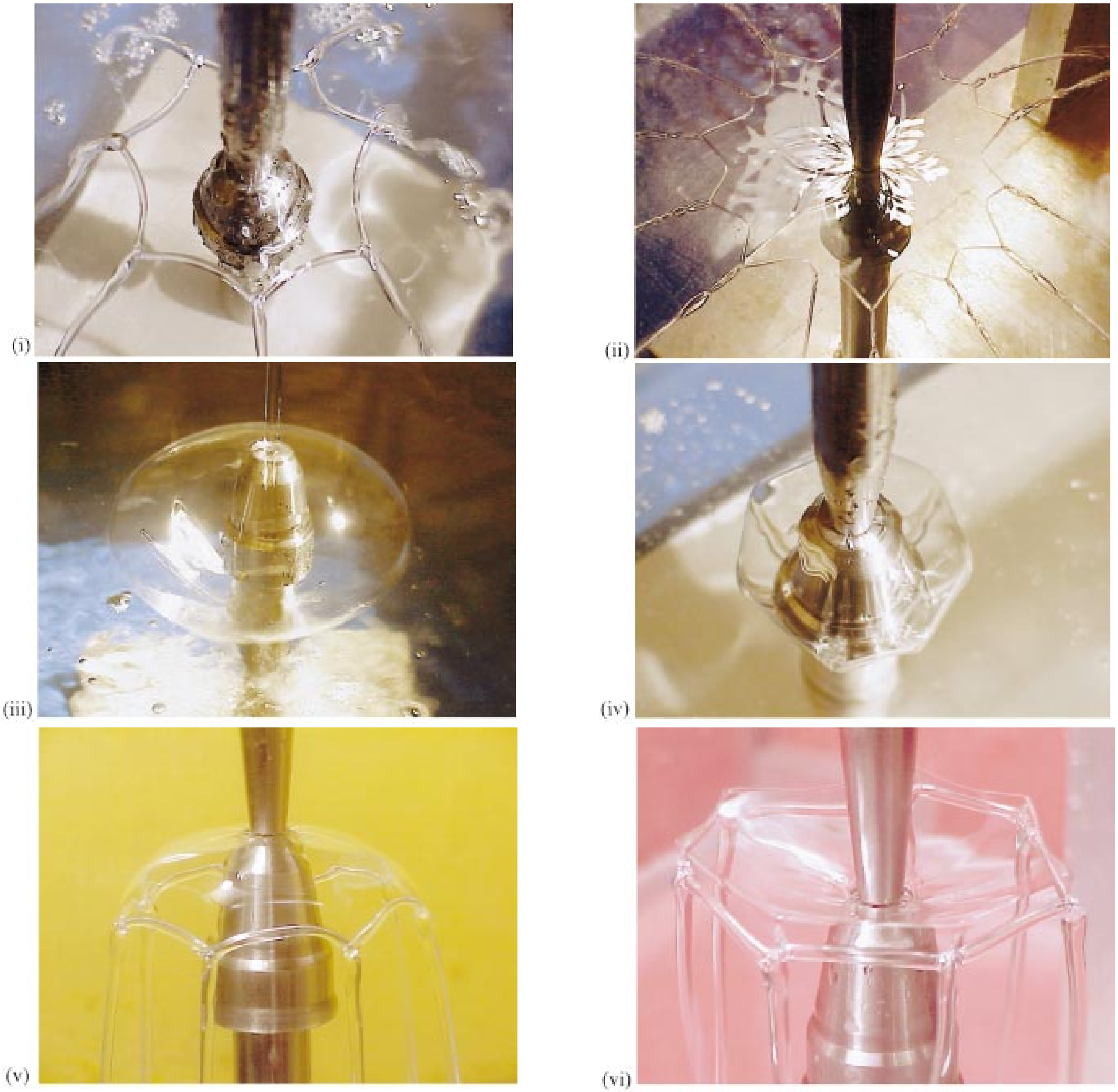

Fluid Polygons

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We examine the topology of fluid sheets and closed bells generated by extruding viscous fluid radially from an annular gap. The source gap width and radius are typically 1 mm and 3 mm, respectively. Glycerol–water or polyglycol solutions with viscosities between 1 and 100 cS are extruded at typical flow rates of 20 cc/s.

The sheets assume a polygonal form with the number of sides varying from 4 to 16. A heptagonal fluid sheet is illustrated in (i). Fluid proceeds from the sheet to the rim, then streams from the corners of the polygon. Low viscosity sheets ($\nu<10$ cS) support a field of antisymmetrical capillary waves[1] which extend to, and prescribe the form of, the sheet rim (ii). The capillary waves transform the axisymmetric closed bell (iii) into a polyhedral form (iv). The capillary waves are not dynamically significant for the high viscosity sheets ($\nu>50$ cS), where the number of sides is determined by the capillary instability of the toroidal rim. Gravitational deflection of the sheets from the horizontal gives rise to fluid umbrellas (v) and parasols (vi). In certain parameter regimes, the fluid exits the corners of the polygons in the form of a fluid chain[2] (ii).

[1] G. I. Taylor, Proc. R. Soc. London, Ser. A **253**, 351 (1959).
[2] M. F. G. Johnson, M. J. Miksis, R. A. Schluter, and S. G. Bankoff, Phys. Fluids **8**, S2 (1996).