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Drag-induced coiling of extruded polymerizing tubes ADITI CHAKRABARTI, SALEM H. AL-MOSLEH, L. MAHADEVAN, Harvard University — When a thin stream of aqueous sodium alginate is extruded into a reacting calcium chloride bath, it polymerizes into a soft elastic tube that spontaneously coils helically under the influence of the ambient fluid drag. We quantify the radius and frequency of this drag-induced coiling instability using experiments, and explain the results using scaling, theory and simulations, as a function of the scaled extrusion rate. We find that the rate of extrusion determines the natural curvature of the tube, which is naturally straight at low extrusion rates, helical at intermediate rates and random at high extrusion rates. By independently controlling the calcium chloride concentration and the extrusion rate, this allows us to 'print' rough features on the tubes. By further co-extruding a second liquid, we can control the relative buoyancy of the tube, allowing us to print complex three-dimensional filamentous structures in the ambient fluid.

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