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Polymer stress anisotropy leads to jetting in rectangular ducts STEVEN HUDSON, PAUL SALIPANTE, CHARLES LITTLE, NIST — Polymer solutions and melts exhibit various flow instabilities. Here we report the characteristics and causes of a jetting flow instability in solutions of entangled worm-like micelles, which are living polymers, and their solutions have strongly non-Newtonian rheology. High resolution particle tracking methods are used to measure the three-dimensional flow field in rectangular microchannels of differing aspect ratios, sizes, and wall materials. The jetting flow is characterized by a localized high velocity region surrounded by much slower flow. We observe that the instability forms in high aspect ratio channels, and that the location of the high velocity jet appears to be sensitive to stress localizations. Jetting is not observed in a lower concentration solution. Simulations using the Johnson-Segalman viscoelastic model show a qualitatively similar behavior to the experimental observations and indicate that compressive normal stresses in the cross-stream directions support the development of the jetting flow.

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