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The Yih mode as a limit in diffuse interface instability: when and how? SUTHEE WIRI, THEO THEOFANOUS, Center for Risk Studies and Safety, Univ. of California, Santa Barbara — Instability of two sparingly-miscible fluids is shown to always approach the sharp interface, Yih-mode, when both the diffuse layer thickness, δ, and molecular diffusivity approach zero ($\delta \to 0, Sc \to \infty$). The physical mechanism of this "Yih-like" instability is discussed, and the quantitative aspects of the approach to the sharp limit are elucidated by extensive coverage of the (dimensionless) parameter space in Poiseuille and Couette flow. The formulation of the mathematical problem differs from that of recent work in the literature in that the (viscosity) constitutive law is applied consistently to both disturbance *and* base flow equations. In the numerical work we found it necessary to meet rather severe spatial resolutions, made possible by the virtual interface method, and to control round-off errors to the extent of quadruple precision. Thusly, significant discrepancies with previous work are accounted for, in the limited parameter spaced covered by these works. More importantly, extension of the parameter space, along with energy-transfer diagnostics on the solutions, allowed the relationship to Yih instability be established and understood. The results are important in setting guidelines for spatial resolution in direct numerical simulations of instability in shear flows, and in providing robust benchmarks for such numerical work.

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