Irregularity of polymer domain boundaries in two dimensional polymer solution

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Domain boundaries of polymer chains comprising a polymer solution confined in strict two dimensions (2D) are irregular, and their fractal dimension (Dp) varies with the area fraction of the solution and the solvent quality. For polymers in θ solvents, Dp remains constant at Dp=4/3 from dilute to semi-dilute phase, but decreases to Dp=5/4 in dense phase. In contrast, Dp in good solvents changes non-monotonically from Dp=4/3 in dilute phase to Dp=5/4 in dense phase, maximizing to Dp≃3/2 at a critical area fraction. Using polymer physics arguments, we rationalize the values of Dp at some limiting conditions. We also put our discussion into the perspective of the Schramm-Loewner evolution (SLE). We find that the maximal irregularity of Dp≃3/2 results from "fjord"-like corrugations formed in domain boundary which also maximize at the critical area fraction. In fact, 2D random curves with Dp=3/2 correspond to the SLEκ with κ=4, which lies at a marginal point, transitioning from simple non-intersecting curves to those with self-intersections.