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Modeling and Analysis of Patterns in Multi-Constituent Systems with Long Range Interaction

Skin pigmentation, animal coats and block copolymers can be considered as multi-constituent inhibitory systems. Exquisitely structured patterns arise as orderly outcomes of the self-organization principle. The free energy functional combines an interface energy favoring micro-domain growth with a Coulomb-type long range interaction energy which prevents micro-domains from unlimited spreading. Analytically, via the sharp interface model, we study the exact shape of global minimizers and also construct stable stationary sets. Numerically, via the diffuse interface model, one open question related to the polarity direction of double bubble assemblies is answered. Moreover, many quantitative results are proved both numerically and theoretically.