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## **Multiphase cross-diffusion models for tissue structures: modeling, analysis, numerics**

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Volume-filling cross-diffusion equations for the components of a tissue structure are formally derived from mass conservation laws and force balances for the interphase pressures and viscous drag forces in a multiphase approach. The equations include Maxwell–Stefan, tumor-growth, thin-film solar cell models as well as novel volume-filling population systems. The Boltzmann and Rao entropy structures are explored. If the drag coefficients are all equal to one, the global-in-time existence of bounded weak solutions, their long-time behavior, and the weak–strong uniqueness of solutions to a regularized system are proved using entropy methods. In the general case, the resulting diffusion matrix is positively stable, ensuring local-in-time existence of solutions. Global-in-time existence of weak solutions is proved if the drag coefficients are sufficiently close to each other. This restriction is explained by the fact that the pressure forces are of degenerate type, while the drag forces are nondegenerate in the volume fractions. Numerical simulations are presented in one space dimension to illustrate the solution behavior beyond the entropy regime.

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