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Analysis of Mixed FEMs for Cahn-Hilliard-Flow Models.

Here I present the analysis of both first order and second order (in time) numerical schemes for Cahn-Hilliard-flow equations. The time discretizations are based on a convex splitting of the energy of the equations and we use a continuous Galerkin discretization of space. Our schemes are unconditionally energy stable with respect to a spatially discrete analogue of the continuous free energy of the system and are unconditionally uniquely solvable. Furthermore, we prove that the discrete phase variable is bounded in $L^\infty(0, T; L^\infty)$ and the discrete chemical potential is bounded in $L^\infty(0, T; L^2)$, for any time and space step sizes, in two and three dimensions, and for any finite final time T . We subsequently prove that these variables converge with optimal rates in the appropriate energy norms in both two and three dimensions. (Received August 10, 2014)