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New upscaled equations for multiphase flows in porous media based on a phase field formulation for general free energies MARKUS SCHMUCK, Maxwell Institute for Mathematical Sciences and Department of Mathematics, Heriot-Watt University, Edinburgh, UK, MARC PRADAS, Department of Chemical Engineering, Imperial College, London, UK, GRIGORIOS A. PAVLIOTIS, Department of Mathematics, Imperial College, London, UK, SERAFIM KALLIADASIS, Department of Chemical Engineering, Imperial College, London, UK — Based on thermodynamic and variational principles we formulate novel equations for mixtures of incompressible fluids in strongly heterogeneous domains, such as composites and porous media, using elements from the regular solution theory. Starting with equations that fully resolve the pores of a porous medium, represented as a periodic covering of a single reference pore, we rigorously derive effective macroscopic phase field equations under the assumption of periodic and strongly convective flow. Our derivation is based on the multiple scale method with drift and our recently introduced splitting strategy for Ginzburg-Landau/Cahn-Hilliard-type equations [1]. We discover systematically diffusion-dispersion relations (including Taylor-Aris-dispersion) as in classical convection-diffusion problems. Our results represent a systematic and efficient computational strategy to macroscopically track interfaces in heterogeneous media which together with the well-known versatility of phase field models forms a promising basis for the analysis of a wide spectrum of engineering and scientific applications such as oil recovery, for instance.

[1] M. Schmuck, M. Pradas, G.A. Pavliotis and S. Kalliadasis, Nonlinearity **26**:3259-3277 2013.

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