ABSTRACT

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Title of the dissertation: Modeling and analysis of multicomponent systems for gas mixtures

The aim of this thesis is to understand and analyze diffussive and thermal effects in multicomponent systems for gas mixtures through the perspective of partial differential equations. Starting from Class–II models of thermodynamics, diffusion equations are derived formally by a Chapman–Enskog expansion and the expansion is justified as a relaxation limit by means of the relative entropy method. The resulting model is analyzed and compared with related models from the literature and a comparison among thermomechanical theories is presented. In the case of zero mean flow, the system reduces to a cross–diffusion system of Maxwell–Stefan type. In the isothermal case, renormalized solutions are employed to prove the uniqueness of weak solutions and an energy study is performed, showing the absence of anomalous dissipation. In the nonisothermal case, the global–in–time existence of weak solutions is studied, using the boundedness–by–entropy method and it is shown that strong solutions are unique in the class of weak solutions, a property known as weak–strong uniqueness.

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