NUMERICAL SIMULATIONS AND APPLICATIONS OF RAREFIED GAS MIXTURES FLOWS

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ABSTRACT

Modeling of rarefied flows of multi-component gases is required in many areas of technology, ranging from evaporation/condensation phenomena in chemical reactors [1] to microfluidic devices [2]. The natural mathematical and numerical basis for rarefied gas flows studies is provided by the kinetic theory of gases and kinetic equations [3], whose complex structure forces the adoption of numerical methods which are computationally quite demanding. Although a large class of problems can be numerically approached by DSMC simulations [4], the adoption of the standard implementation of particles schemes can be problematic when applied to flows resulting from small deviations from equilibrium, to unsteady flows or to gas mixtures flows which contain small amounts of one or more components. In the cases listed above, deterministic schemes combined with kinetic model equations [5] or semi-deterministic schemes for the direct solution of the Boltzmann equation [6] offer interesting and computationally viable alternatives to particle schemes.

The present work aims at reviewing models and computational tools for rarefied gas mixtures flows and to present their applications to vapor deposition flows [5], where flow unsteadiness, small departures from equilibrium and trace components may all be present in some circumstances.

REFERENCES