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A unified model from dense and dilute compressible multiphase flows - application to explosive dispersal[1] Y. LING, Institute Jean le Rond d'Alembert, Université Pierre et Marie Curie, S. BALACHANDAR, Department of Mechanical and Aerospace Engineering, University of Florida, T.P. MCGRATH, J. ST. CLAIR, Naval Surface Warfare Center, Indian Head Division — Compressible multiphase flows are commonly seen in nature and industrial applications, such as volcanic eruptions and multiphase explosions. A fundamental challenge in modeling of compressible multiphase flows arise from rapid evolution of the volume fraction of the dispersed phase. For example, in multiphase explosions, the volume fraction of particles can change from the close-packing limit to lower than 1% in milliseconds. Since the dominant physics are substantially different in the dense and dilute multiphase flow regimes, the models in the literature for these two regimes are typically different. To accurately simulate compressible multiphase flows involving fast transition from dense to dilute regimes, a novel model that covers both dense and dilute regimes is proposed in this study. A particle volume fraction equation is introduced, which reduces to the particle compaction equation in the dense regime. The present model also includes the added-mass force in the interphase coupling, which has been shown to be important in capturing shock-particle interaction in previous studies. A characteristic analysis of the present model is performed and the effect of added-mass force on acoustic speed of the multiphase system is also analyzed.

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