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A Developed Approach for Incorporating the Equations of State into the Shan-Chen model

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ABSTRACT

Owing to its simplicity and flexibility, the lattice Boltzmann method (LBM) is an alternative method to the conventional computational fluid dynamics (CFD) techniques in simulating a single-phase and multiphase fluid flows, and transport phenomena, successfully and efficiently. The Shan–Chen (SC) model is the most widely used model in the open literature due to its simplicity and flexibility in simulating multiphase systems. In this work, a method to incorporate the Equations of State (EoS) into the SC model is proposed and analyzed. Three popular EoSs—van der Waals EoS, Redlich–Kwong EoS, and Carnahan and Starling's EoS—are coupled with the SC model. The difference between previously proposed approaches and the current one is in the manner of determining parameters (*a* and *b*) of the EoS. In the developed approach, the parameters become a function of the critical properties of a substance. The effects of an arbitrary constant (ρ_o), temperature, and the controlling strength parameter (*G*) on surface tension are discussed. The results show that the SC model sometimes yields negative values of surface tension when ρ_o is set below 1.5. The developed model enhances the flexibility of the SC model in simulating a single component multiphase system.