Numerical Simulation of Gas-Liquid Flow in a Flat Bubble Column using the Lattice-Boltzmann Scheme

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Bubble columns are widely used in the chemical and pharmaceutical industry to produce a variety of products. It has been known, that these devices are characterized by a high degree of unsteadiness and complexity(3). Thus, a detailed understanding of liquid field and bubble dispersion pattern is crucial in design and scale-up bubble process.

By using computational fluid dynamics (CFD) modeling it is possible to gain an insight into flow and mixing of gas-liquid. Although significant efforts have been invested in this field, challenges still remain. For example, fully resolved 3D simulations of commercial-scale bubble columns are prohibitively expensive for conventional CFD models. Therefore, we focus on developing a reliable computational tool with high efficiency in parallel computation.

In this work we studied gas-liquid flow in a laboratory-scale bubble column (the Becker case(3)) by means of large-eddy simulation (LES) combined with Lagrangian particle tracking with two-way coupling. This approach is known as the Eulerian-Lagrangian (E/L) method. The same lattice-Boltzmann scheme as employed by Derksen(2) is extended for discretizing the multi-phase Navier-Stokes equations. To the best of author’s knowledge, this is the first time to use the lattice-Boltzmann scheme with Lagrangian particle tracking to simulate a bubble column. We chosen this scheme because of its computationally efficiency especially on parallel computer platforms(2). Our work also includes a smart scheme(4) for checking the distance between the particles and the cells. Good agreement with experimental data(1) for the mean velocities and transient bubble dispersion patterns is obtained.

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