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Niels G. Deen, E.A.J.F. Peters, Johan T. Padding, J. A.M. Kuipers



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**Review of Direct Numerical Simulation of Fluid-Particle Mass, Momentum and Heat
Transfer in Dense Gas-Solid Flows**

Niels G. Deen*, E.A.J.F. Peters, Johan T. Padding and J.A.M. Kuipers

Multiphase Reactors Group

Department of Chemical Engineering and Chemistry

Eindhoven University of Technology

P.O. Box 513, 5600 MB Eindhoven, The Netherlands

*) Corresponding author, E-mail: N.G.Deen@TUE.nl

Abstract

This paper reviews the use of direct numerical simulation (DNS) models for the study of mass, momentum and heat transfer phenomena prevailing in dense gas-solid flows. In particular, we consider the DNS models as the first important step in a multiscale modeling strategy. Both the merits and the limitations of different DNS methods are discussed, in particular for the field of fluidized bed modeling. The importance of the closures for interfacial transfer of mass, momentum and heat, obtained from DNS and applied in coarser scale models, is demonstrated with illustrative examples. Finally, we present our view on required future developments of DNS models for the investigation of various chemical engineering problems.

Key-words

Direct Numerical Simulation; Immersed Boundary Method; Fluidization; Fluid-Particle Momentum and Mass and Heat Transfer; Multi-Scale Modeling

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