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Direct numerical simulation of fluid-particle mass, momentum, and heat tranfers in reactive systems. ABDELKADER HAMMOUTI, ANTHONY WACHS, IFP Energies Nouvelles — Many industrial processes like coal combustion, catalytic cracking, gas phase polymerization reactors and more recently biomass gasification and chemical looping involve two-phase reactive flows in which the continuous phase is a fluid and the dispersed phase consists of rigid particles. Improving both the design and the operating conditions of these processes represents a major scientific and industrial challenge in a context of markedly rising energy cost and sustainable development. Thus, it is above all important to better understand the coupling of hydrodynamic, chemical and thermal phenomena in those flows in order to be able to predict them reliably. The aim of our work is to build up a multi-scale modelling approach of reactive particulate flows and at first to focus on the development of a microscopic-scale including heat and mass transfers and chemical reactions for the prediction of particle-laden flows in dense and dilute regimes. A first step is the upgrading and the validation of our numerical tools via analytical solutions or empirical correlations when it is feasible. These couplings are implemented in a massively parallel numerical code that already enable to take a step towards the enhanced design of semi-industrial processes.

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