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Multiphase flow physics in aerospace technologies

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Multiphase flow physics is essential in large variety of practical applications: e.g. aircraft icing, erosion and ablation in dusty atmospheres, combustion, medicine and space problems. Despite numerous experimental and numerical investigations, some physical peculiarities of supercooled droplets crystallization physics understanding as well as nonspherical particles motion simulation in nonuniform flows are not complete. Panoramic optical methods could be essentially improved in order to get more information from wind tunnel experiments. Mathematical models and numerical algorithms for calculating the motion of nonspherical ice crystals in inhomogeneous media have been developed and compared with corresponding experimental results. Methods for inverse problems of disperse flows parameters determination via analysis of panoramic optical measurements data were developed. Based on the results of experimental studies, dependencies of the characteristics of the crystallization of a supercooled liquid in the problem of icing of aircraft were obtained. Physical peculiarities were discovered and experimentally fixed. Methods of molecular physics were used to estimate supercooled droplets crystallization features parameters. Computational algorithms and mathematical models for dispersed flows interaction with a solid surface control at the molecular level were developed. Results of parametrical investigations are obtained as well as corresponding illustrations.

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