Not Fully Stable Fluids under Controlled Pulse Heating

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The thermophysical properties of fluids in absolutely stable states, at least for pure liquids, have been investigated sufficiently well. Generally, these properties may be repeatedly measured, since for such states reliable experimental methods have been developed. Because of the obvious experimental difficulties, the properties of not fully stable fluids are less studied. Moreover, a search of suitable methods for solving this problem is still in progress. We shall call not fully stable fluids those that lose stability in the course of heating (superheated liquids and thermally unstable ones), as well as initially unstable systems (nanofluids and supercritical ones). We are developing an experimental approach to investigation of the properties of not fully stable fluids based on the procedure of controlled pulse heating of a thin wire probe. The method allows one to select the entrance trajectory (in time-temperature variables) into the region of superheated states in accordance with a number of thermal properties and with a set of relaxation times for the system, to detect the characteristic boiling-up signal on the heating curve, and to determine the substance temperature and the heat-flux density from the probe at any given moment. In this report, the 15-years evolution of the method is reviewed. The essential results to be discussed include the characteristic temperature of attainable superheat and the approximation of the critical properties for liquid/gas mixtures and polymeric melts; the effective thermophysical properties of nanofluids and solutions with LCST; the effect of considerable reduction of the heat conduction in supercritical fluids, as compared to that in subcritical liquids.

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