Rapid transformation of solutions into an unstable state as a new way to heat transfer enhancement

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At this moment, boiling of the coolant remains the main method for intensifying heat transfer in the case of typical-sized cooling systems. In microchannel systems, boiling also promotes cooling, but is accompanied by the formation of dry spots on the heat transfer walls and their local superheating. In general, the intensification of heat transfer can be performed due to the spinodal decomposition of a binary coolant. Spinodal decomposition is a phase transition associated with the separation of a solution by the liquid-liquid mechanism. It is accompanied by the intensification of heat transfer and excludes pressure surges typical of the coolant boiling.

The aim of this work is to study the processes of heat transfer to pulsed superheated (with respect to the diffusion spinodal) solutions with respect to heat transfer observed in the region of stable states of the solution and in pure components under comparable experimental conditions, including against the background of a liquid-liquid phase transition and spinodal decomposition.

The method of controlled pulsed heating (t 0.1 s) of a wire probe in the temperature plateau mode was used to study aqueous solutions of oligomers, having lower critical solution temperature. The values of the instantaneous heat transfer coefficient for four aqueous solutions of glycols have been determined. On the phase diagram of solutions, the regions of spinodal decomposition were determined and the instantaneous heat transfer coefficient for these solutions was found to exceed the corresponding value of pure water (as a reference substance) up to three times. Recommendations are proposed for the selection of working fluids in the design of advanced cooling systems for compact electronic devices.