Estimation of Critical Data and Phase Diagrams of Pure Molten Metals

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Measurements of thermophysical properties of liquid metals are demanding and thus rare. A recently published data collection provides high temperature data for a set of 22 metals [1]. Although the measurements concern data in the range up to 5000 K, the critical region however, is mostly far beyond the region accessible experimentally at present, with exceptions of Alkali metals. Knowledge of the phase diagrams and of the critical data is important for high-temperature technologies and also of fundamental interest. Therefore an attempt is made to extrapolate the available data into the critical region. A novel approach for extrapolating the density data [2] is applied taking into account recent theoretical developments in the field of critical phenomena, which are the crossover from the universal criticality of the 3d-Ising model towards mean-field behavior, and the theory of complete scaling that describes the nonlinearity of the diameter of the phase diagrams. The method is tested on phase diagrams of Cesium, Rubidium, and Mercury for which accurate phase diagrams up to the critical region are available and compared with simulation results and other estimation methods e.g. such that are based on inter-atomic potentials or surface tension measurements. Comparison is made with measurements of the critical temperature by the 'exploding-wire technique' e.g. of Gold, Lead and Zinc. Corresponding state behavior of the metals is established.

References

[1] G. Pottlacher, High Temperature Thermophysical properties of 22 pure metals, Edition Keiper, Graz, ISBN No. 978-3-9502761-6-9, 2010.
[2] W. Schroer, G. Pottlacher, HIGH TEMPERATURES-HIGH PRESSURES 43, 201-215 (2014).