

Surface Tension of Supercooled Water Down to -21°C Measured within a Horizontal Capillary Tube

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New data for the surface tension of metastable supercooled water, i.e., the liquid water at temperatures below the equilibrium freezing temperatures, is presented in this study. A new experimental apparatus based on the measuring technique developed by Ferguson and Kennedy [1] was recently designed and tested [2]. A short liquid thread with a length of 2-3 cm was located in a horizontal capillary tube with inner diameter around 0.3 mm. One end of the capillary tube was connected to the pressure setup with inert gas, while the other end was left open to ambient. The open end of the capillary tube was observed with an optical setup consisting of a laser source, optical prism, lens, and a digital camera. A pre-set overpressure of inert gas in order of hundreds of Pa applied to the closed end of the capillary tube gradually changed the liquid meniscus at the open end from concave to planar and subsequently to convex. The surface tension at the inner liquid meniscus was determined from the overpressure of inert gas corresponding to the flattened outer meniscus. The surface tension of supercooled water was successfully measured down to -21°C. The new data obtained from the horizontal technique agrees well with our previous measurements performed with the modified capillary rise method [3]. The data can be well reproduced with the IAPWS correlation for the surface tension of ordinary water [4] extrapolated below 0.01°C.

References

- [1] A. Ferguson, S.J. Kennedy: Proc. Phys. Soc. 44, 511 (1932)
- [2] V. Vinš, J. Hošek, J. Hykl, J. Hrubý: Int. Conf. Experimental Fluid Mechanics 2014, Český Krumlov 18.-21. November 2014 (CZ) 694-699
- [3] J. Hrubý, V. Vinš, R. Mareš, J. Hykl, J. Kalová, J. Phys. Chem. Lett. 5, 425 (2014)
- [4] IAPWS release on surface tension of ordinary water substance. 1994; <http://www.iapws.org>