Measurements of Speed of Sound in Argon for Thermodynamic Temperature Measurement

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An acoustic gas thermometry (AGT) system was built at the National Metrology Institute of Japan (NMIJ). This AGT system introduced two one-liter quasi-spherical resonators (QSR) made of oxygen-free copper. One prototype QSR, which was fabricated using a conventional NC machine, and one advanced QSR, fabricated using diamond-turning, were tested by measuring the speed of sound in argon at the temperature of the triple point of water and the melting point of gallium. The effective radius was determined by microwave measurements. Measurements were conducted at pressures ranging from 60 kPa to 700 kPa. The speeds of sound in the zero pressure limit were also obtained through extrapolation of these data. Based on the obtained speed of sound at the triple point of water and the melting point of gallium, the Boltzmann constant and the thermodynamic temperature were determined. This paper reports the speed of sound measurements and the obtained thermodynamic temperature between the triple point of water and the melting point of gallium.