Performance of Acoustic Gas Thermometer of Cylindrical Resonator Machined by Diamond Turning

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Acoustic Gas Thermometers (AGTs) play the major role in measuring thermodynamic temperature through accurate measurements of speeds of sound for dilute gases. The AGT of fixed-path-length cylindrical resonator is an important branch of AGTs. It has shown some preference characteristics in accurate measurements of speeds of sound of dilute gases. Nevertheless, the inconsistency among different modes is the dominant drawback of such AGTs. We made a new oxygen-free copper cylindrical resonant cavity that was machined with the high-precision diamond-turning procedure. The performance of the AGT with the new cavity was assessed through measurements of three non-degenerate longitudinal modes at 273.16 K. The equal and non-equal spaced frequency interval were applied for the scanning of resonant profiles. The corrections of perturbations have been implemented to extract the unperturbed resonant frequencies. The surface fitting for the acoustic virial relation has been made over experimental data in the pressure range from 100 kPa to 550 kPa. The first virial coefficients yielded, such the square speeds of sound at the ideal gas state, agree in the fractional differences of smaller than two parts per million. The new measurements turn out an improvement with the comparison of the previous experimental data obtained by the authors. The new progress is helpful for application of AGT in fixed–path–length for accurate measurement of thermodynamic temperature in large range.