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A novel wide-range apparatus developed for performance testing of molecular pump

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As an effective tool to acquire ultra-high vacuum (UHV), molecular pump is widely used in scientific research and advanced manufacturing, and the performance testing of molecular pump is of great importance to its quality evaluation and the design for UHV system. This presentation will not only give a thorough introduction of a novel wide-range testing apparatus of molecular pump developed by Beijing Engineering Technology Research Center for Vacuum Metrology and Testing, but also show the results of the testing program organized by Chinese Vacuum Society (CVS) in 2017 to evaluate all kings of the molecular pumps used in China.
Comparing with other testing apparatuses of molecular pump based on dynamic conductance method or flowmeter method, the newly-developed testing apparatus extends the measurement ranges of pumping speed, compression ratio, as well as ultimate vacuum in the following ways: I) the apparatus is designed by well-modularized method and composed of three modules, that is, gas flowmeter module, test chamber module and calibration module; II) a newly-developed combining standard gas flowmeter providing a fine control of gas flow in the range of 10˜10-12 Pam3/s is applied in the gas flowmeter module, and only by this method, the pressure in the test chamber can approach the range of 1˜10-8 Pa in the testing process; III) the test chamber module consists of a series of test chambers with different sizes to meet the needs of various molecular pumps; IV) to improve the accuracy of measurement, the pressure of test chamber is measured by a combination of a capacitance diaphragm gauge (CDG), a spinning rotor gauge and an extractor gauge, in which the spinning rotor gauge is used as a reference standard to in situ calibrate the extractor gauge in the range of 10-2～10-4 Pa; V) the outlet pressure of the molecular pump is measured by a combination of gauges with range of 1×10-2˜1×105 Pa, which can extend the range of the compression ratio.
The experimental results show that the newly-developed apparatus can reach the pumping speed range of 1˜6000 L/s with a combined standard uncertainty of 1.6%˜2.6%, the ultimate pressure range of 10-3˜2×10-10 Pa with a combined standard uncertainty of 1.2% ˜3.0% and a compression ratio range of 10˜1012 with a combined standard uncertainty of 1.3% ˜ 3.2%.

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