Abstract of the dissertation

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Basic studies for the development of a long-term-stable cold-cathode ionisation gauge of the inverted magnetron-type

If a cold-cathode gauge is operated in a hydrocarbonous gas atmosphere at high pressures, its mean life-time is substantially limited by a contamination of its discharge electrodes and thus by a strong change of the gauge characteristic. Consequently, the pressure reading of the gauge becomes erroneous or the gauge can even completely fail. The present work reports on the development, the structure and the testing of an improved cold-cathode ionization gauge for pressure measurements in the vacuum range, which was specially designed for long-term operation in residual gas atmospheres with high portions of hydrocarbons at higher pressures. Starting point for the considerations were intensive preliminary investigations on the long-term measuring behavior of commercial cold-cathode ionization manometers and the exact analysis of the contamination process of cold-cathode gauge heads. The contamination of cold-cathode gauge heads is mainly caused by two physical effects: on the one hand the sputtering of the cathode material through the ions formed in discharge results in the coating of the walls and insulating surfaces of the discharge chamber. On the other hand polymerization processes and plasma-chemical reactions proceed in the plasma. Both processes cause the deposition of thin films of carbon or polymers on the walls of the discharge chambers and electrical insulators which modify strongly the discharge conditions.

Based on these conclusions, a new cold-cathode gauge was developed in which this contamination effect runs temporally strongly retarded. Hereby a substantially longer useful life-time of the gauge should be reachable. The result of the development work was a new, patented and long-term-stable cold-cathode gauge of the inverted magnetron-type, which is characterized by a three times higher useful life-time compared to commercially available cold-cathode gauges. It was realized by a modification of the classical inverted magnetron gauge structure using a special electrode geometry with two separate and independent discharge chambers in one common gauge housing. Whereas the discharge zone positioned directly at the tube entrance works only as ion baffle, the second discharge zone located more interior is used only as gauge for pressure measurement. This special double-plasma configuration has the crucial advantage that the plasma zone located at the entrance of the gauge protects the inside one (which represents the measuring cell) as far as possible against disturbing contamination by condensable or hydrocarbonous gases and vapors.

The work describes the development steps of the prototype of the gauge in detail and presents first test results on the fundamental operational behaviour as soon as studies of the long-term measuring behavior of the new sensor head. The evaluation of these results confirm the correctness of the considerations to the structure of measuring tube with two separated discharge chambers in view on an increased life-time of the gauge system.