Vacuum Technology for Electron Microscopy

Broad portfolio of reliable, high quality vacuum solutions for critical Electron Microscopy and Analytical Instrumentation challenges

Introduction

Optical microscopes that use light and glass lenses to generate an image were the industry standard until the early 20th century. At that time, the invention of the Electron Microscope (EM) revolutionized imaging. An electron microscope works on the same general principle as an optical microscope but uses electrons and electromagnets instead of light and lenses to enable much higher image resolution; important in both high technology and life sciences where the ability to properly characterize complex samples is critical. This high precision analytical instrument is used to characterize and identify a wide variety of sample types from semiconductor chips and pharmaceutical drugs to organic and genetic structures.

The electron microscope consists of an electron generating column, system electronics, and sophisticated software to make sample viewing, labeling, storage and analysis much easier. Electron microscopes come in various types, such as Transmission, Scanning and Field Emission, as well as vacuum levels to suit different applications. High vacuum ensures that small electrons are not deflected from their path by other gas molecules, dust or debris, resulting in poor image quality and improper sample characterization. The electron gun assembly used to generate high energy electrons is also operated under vacuum to prevent electrical discharge from escaping the system.
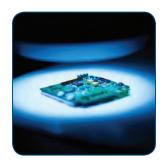
MKS products solve key challenges in Electron Microscopy manufacturing with solutions in:

- Custom Vacuum Machining
- Pressure & Vacuum Measurement
- Vacuum Isolation Valves
- Advanced Data Analytics
- Automation & Control

New Challenges in Electron Microscopy

The need to analyze a broader range of smaller samples along with newer design specifications introduces new challenges in electron microscopy. Ultra-precise vacuum components as well as comprehensive data analytics capabilities will be required to support advances in electron microscope technology.

Some of the key challenges today include:

- Stringent resolution, sample throughput and measurement requirements
- Sustained, consistent vacuum levels for electron beam integrity and near zero vibration
- Hyphenated techniques – seamless integration with other analytical instruments
- Rapid, automated sample data processing and analytics

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MKS Solutions

Bouncing electrons off a sample requires a tightly controlled vacuum environment to ensure image integrity resolution. To preserve electron beam integrity, the vacuum chamber must be completely free of scratches, aberrations, contaminates and properly vacuum sealed. MKS Custom Vacuum Solutions offers state-of-the-art machining, welding, finishing and cleaning, as well as sub-assembly, assembly and system testing of components, electromechanical assemblies and analytical instruments to Ultra High Vacuum (UHV) standards.

It is critical to maintain vacuum levels within the chamber. Even a tiny leak could compromise image resolution resulting in inaccurate results. MKS is the global leader in pressure, vacuum measurement and control. Customers turn to MKS Granville-Phillips® Vacuum Gauges for
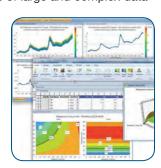

reliable, precise vacuum measurement across a wide vacuum range, from 10^{-11} Torr to 1,000 Torr, for the most demanding analytical instrumentation applications. MicroPirani™, Micro-Ion® and hot and cold cathode gauges offer high quality, increased reliability and superior lifetime performance.

In addition, MKS' best-in-class Baratron® Capacitance and Dual-range Manometers are top-rated in the industry. Other MKS products and solutions such as Pressure Sensors, Switches, Control Subsystems, Vacuum and Pressure Gauges and Controllers provide long term reliability and stability resulting in high sample throughput, up-time and yields.

MKS is a leader in high reliability, precision stainless steel vacuum isolation and pressure control valves. The Ultra High Vacuum Valve (UHV) uses metal Con-Flat flanges to limit outgassing and permeation for all vacuum-to-atmosphere seals and is assembled in a Class 100 cleanroom. The MKS family of vacuum isolation valves features heated or unheated angle and inline configurations, safety shut off valves and soft start valves.

Access to advanced data analytics is becoming increasingly critical as data sets become larger and more complex and sample throughput requirements increase. MKS Data Analytics Solution's innovative advanced analytics software enables easy and rapid analysis of large and complex data sets. The MKS Umetrics Data Analytics Suite is a complete package that includes sophisticated software for design of experiments (MODDE®) and multivariate data analysis (SIMCA®). The Suite also includes real-time process monitoring software that enables early fault detection and early quality prediction.

Scientists are increasingly linking electron microscopy to other analytical techniques and platforms in order to perform complete physical and chemical analyses. With rapid advances in data networking, seamlessly connecting data generated from individual equipment platforms—typically from different manufacturers with various protocols—is becoming a huge challenge. The MKS Automation Platform can be configured to meet many automation and control applications, ranging from those requiring simple I/O or other control networks all the way up to a fully programmable controller, seamlessly connecting to MKS data analytics and other MKS products or manufacturers.

MKS is a leading global provider of vacuum technology products for analytical instrumentation manufacturing, medical equipment manufacturing, research laboratories, semiconductor and other advanced manufacturing applications. We are committed to helping our customers solve their most complex problems.