Thin Film Vacuum Coating

Introduction

Thin film vacuum coating processes change surface characteristics by applying a very thin, highly uniform coating to a 2 or 3 dimensional surface. Thin film optical coatings can improve transmission or reflection properties in devices like optics, architectural glass and solar panels. Thin film tribological coatings reduce friction and increase wear resistance on products such as machine tools, medical instruments and automotive parts. Thin film coatings can also be used in packaging applications to improve product freshness, and are used for decorative purposes as well.

Operating under vacuum enables control of the chemical composition and physical properties of a coating process. Vacuum reduces gas and particle density which improves film composition and reduces contamination, while facilitating extremely uniform deposition with molecular or even atomic level precision. The use of vacuum also enables low pressure plasma processing and enhances control of gas composition and flow.

Precision control of the deposition process is key to vacuum coating. Deposition can be either chemical, known as CVD, or physical, known as PVD. In CVD one or more volatile precursors react with or decompose on the surface of a substrate producing the desired coating. In PVD mechanical or thermal energy dislodges particles which are transferred to the surface to be coated.

MKS products solve critical challenges

in the creation, control, composition and uniformity of thin film vacuum coating with high performance solutions in:

- RF Power
- Remote Plasma
- Pressure Control
- Flow Control
- Automation
- Ozone Delivery
- Gas Analysis
- Leak Detection
- Data Analytics

Challenges in Thin Film Vacuum Coating

Prior to vacuum coating, substrates must be clean and ready for the deposition process to take place. Surface preparation and cleanliness are critical to high quality, uniform deposition.

To achieve vacuum, there can be no leaks or virtual leaks in the vacuum system. Sources of leaks include bad seals and poor welds, while virtual leaks are caused by small amounts of trapped gas within the system.

Quality of the vacuum process is affected by a number of factors. To produce parts with the required chemical stoichiometry, gas pressure and chemical composition are critical and must be accurately monitored and controlled in real time. Accurate gas pressure control is required to assure proper pump operation and plasma compatible conditions. Additionally, the energy provided to the process, whether thermal or plasma based, is extremely dependent on gas pressure and composition.

To produce the energy needed to create the chemical or physical reaction which results in deposition, power, in the form of heating or a plasma discharge, is delivered into the vacuum chamber. Additionally, when deposition occurs in the chamber, material is deposited not only on the substrate but also on the walls of the chamber. To maintain cleanliness and consistent conditions, this excess deposited material must be periodically removed from the walls of the process chamber.

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MKS Solutions

Substrate Cleanliness

MKS' LIQUOZON® Dissolved Ozone Delivery systems are used in thin film vacuum processes such as solar cell manufacturing to clean the substrate surface and eliminate organic contaminants, metals, and particles.

Vacuum Integrity

To ensure vacuum integrity, MKS offers Residual Gas Analyzers (RGAs) and vacuum quality instruments to detect vacuum leaks and monitor the composition of the gases in the process.

Gas Flow and Delivery

MKS' family of mass flow controllers (MFCs), in-situ mass flow verifiers, and flow ratio controllers accurately and repeatably divide gas flows into precise flow streams to multiple points in the process and provide repeatable gas doses into the process.

Pressure Measurement and Control

Dynamic pressure control provides the best opportunity to achieve consistent and stable vacuum conditions. To achieve this balance MKS Baratron® capacitance manometers, flow control, valves and Granville-Phillips® gauges are used to accurately and repeatably control process pressure.

Power Generation

MKS RF Power Generators provide reliable solid state power for thin film processing equipment. Combined with our Impedance Matching Network and V/I Probe, these instruments form a complete RF delivery system.

Plasma Sources

MKS pioneered remote plasma sources for chamber cleaning and is the leading supplier of plasma sources for process chamber clean. Additionally, MKS produces the Process Sense, an NDIR based end-point detector, to optimize chamber cleaning and monitor effluent gases.

Process Monitoring

Residual Gas Analyzer Vacuum Process Monitors analyze the partial pressures of vacuum residuals, providing highly accurate end point detection. These analyzers provide the highest sensitivity measurements of gas species present in a vacuum. With robust sensors that keep working even in harsh process environments, RGAs acquire the highest quality of data at the fastest possible speeds.

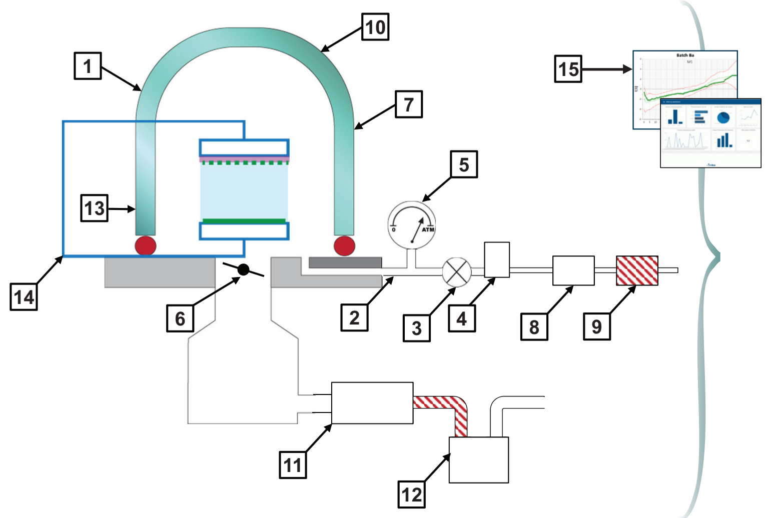
Automation and Control

To ensure comprehensive process control, the MKS Automation Platform can be configured for use in many applications—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.

Data Analytics

Consistent process yields can only be sustained with statistical process control. The MKS Umetrics™ data analytics suite is the leading software solution for multivariate data analysis, design of experiments, data visualization of large datasets, and for process control.

MKS Instruments is the worldwide leader in technology solutions for vacuum processing.



1. Custom Vacuum Chambers
2. Vacuum Fittings & Components
3. Valves
4. Gas Flow Measurement & Control
5. Pressure/Vacuum Gauges
6. Pressure Controllers
7. Residual Gas Analyzers
8. Vapor Delivery Systems
9. In-line Filters and Heaters
10. Leak Detectors
11. Optical Gas Analyzers
12. Effluent Management Systems
13. Remote Plasma Sources
14. RF & DC Power Generators
15. Data Collection, Multivariate Analysis, Statistical Control