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A NOVEL SENSOR USING REMOTE PLASMA EMISSION SPECTROSCOPY FOR MONITORING AND CONTROL OF VACUUM PROCESSES

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Plasma emission monitoring (PEM) has been used for a number of years to either monitor the condition or actively control vacuum processes that rely on plasma generation (e.g. Physical Vapour Deposition). This approach to monitoring the process has many advantages such as fast response time, monotonic sensor behaviour and the ability to control uniformity by monitoring different areas of the process. There are however some disadvantages, e.g. there is required a clear line of sight to the plasma that can be obscured by substrate movement, the PEM sensor can become coated by the deposited material and, of course, it can be only be used when the process itself generates a plasma.

Concepts using a remotely generated plasma were developed to address these issues. A convenient method of generating the remote plasma is to use a cold cathode pressure gauge. This sensing method, sometimes referred to as "Penning PEM", has been used successfully to control a number of process types including non-plasma processes such as reactive E-Beam evaporation.

A new type of remote plasma generator has been developed, which when combined with advances in miniature spectrometers can be used to perform optical plasma spectroscopy. This has the potential to facilitate its use as a low-cost, multi-purpose vacuum sensor. Presented are a number of examples of its use as an intelligent pressure gauge (penning pressure measurement in conjunction with plasma spectroscopy), etching process monitoring, vacuum quality monitoring, and reactive deposition control.

Also presented is a novel method of sensing species indirectly via the emission lines relating to the sputtered material from inside the sensor. This is shown to enable monitoring and control of processes using remote PEM that are otherwise not possible via conventional plasma spectroscopy.

Keywords

Sensors

Control

Plasma Spectroscopy

Plasma Emission Monitoring