

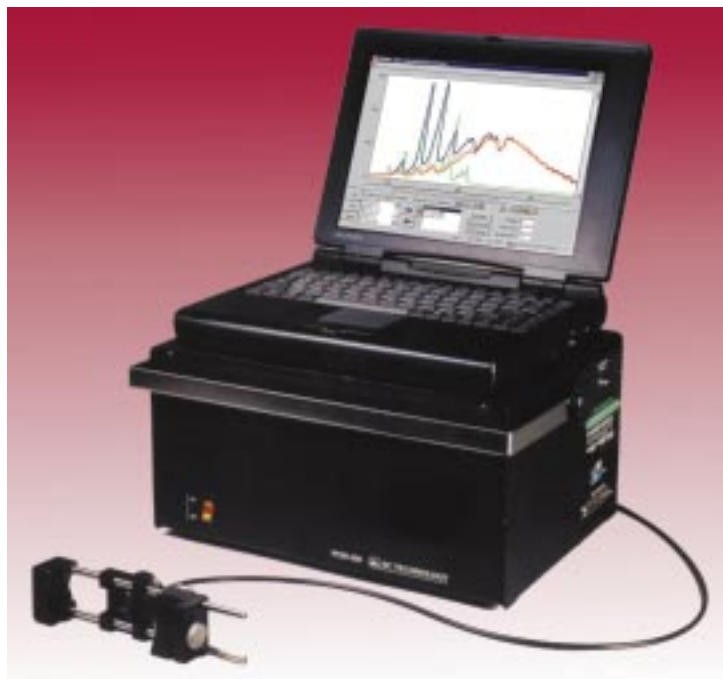


Optical Solutions from

SC TECHNOLOGY

Plasma Chemistry Monitor 420

Instrumentation for Plasma Diagnostics and Endpoint



The Plasma Chemistry Monitor 420 is a powerful optical tool for plasma processing control. It can be used in the research, plasma process development and production stages of plasma semiconductor manufacturing. Applied optical spectroscopy with the PCM 420 is simpler than ever without sacrificing accuracy or instrument features.

Think of a state-of-the-art spectrograph and light detector, seamlessly integrated with user-friendly Windows software designed for plasma diagnostics and process control. This instrument is more than just the sum of its parts.

Some examples of the PCM 420 applications are:

- Plasma etch endpoint detection and algorithm development
- Reactive sputtering control
- Process simulation and optimization
- Chamber gas purity control and chamber leak detection
- General plasma diagnostics
- Chamber qualification, matching and troubleshooting

Tell us about your specific problem, we can customize our product to your application.

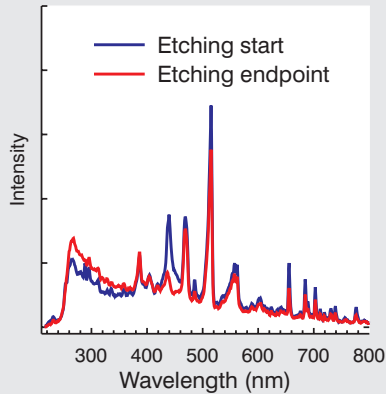
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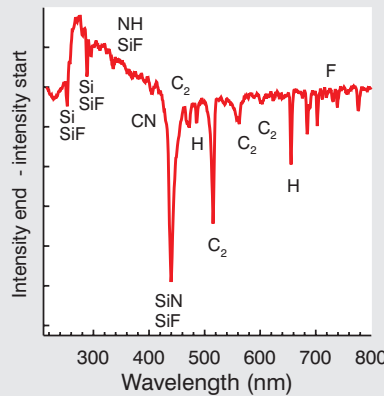
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Plasma Diagnostics/Endpoint

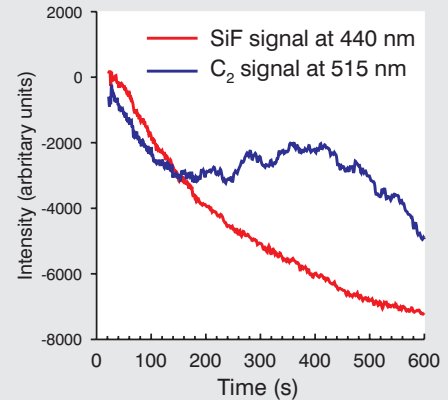
Determination of etching endpoint



The light emitted inside the chamber during the etching process is recorded by the PCM 420 in a spectra time series at a rate up to 40 spectra per second. The figure above show the spectra recorded at the beginning and the end of the etch.



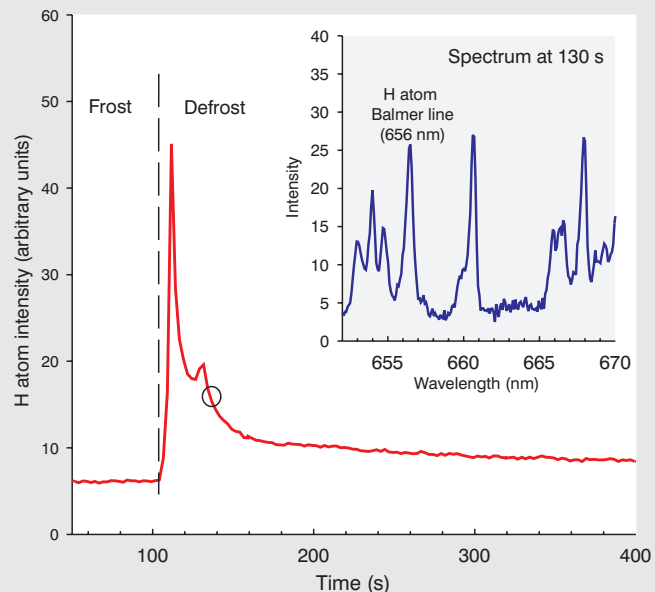
Intensity changes in spectral lines can be easily visualized by subtracting the first spectrum using the normalization option in the software. Although the composition of the chamber gas is not known, spectral lines are identified with the built-in database and are assigned to plasma species with little ambiguity. The presence of SiF, F, H, C₂ ... points out the possibility of a CF₄ + CF₃H plasma in the chamber.



Different species give information about distinct aspects of the etching process. Wavelength equations together with digital filters are used to determine the endpoint accurately, monitor plasma health and detect impurities. In the figure, the SiF time evolution is a good endpoint marker, the C₂ may be used to detect anomalies in etching a polymer layer on the silicon wafer.

Water monitoring during sputtering

Water is often an undesirable impurity in plasma processing. In an oxygen and argon plasma, water is dissociated by electron impact forming excited OH and H fragments. The light emitted by H and OH is identified by the PCM 420, and is recorded during sputtering. The insert in the figure shows the region of the spectra where the H atom Balmer line (656 nm) is unequivocally identified. The PCM 420 high resolution mode of 0.3 nm permits the separation of the H atom line from other plasma species. In this example, the PCM 420 is successfully used to monitor the water concentration during the defrost step. This is accomplished following the optical emission intensity variation of just one of the plasma species.

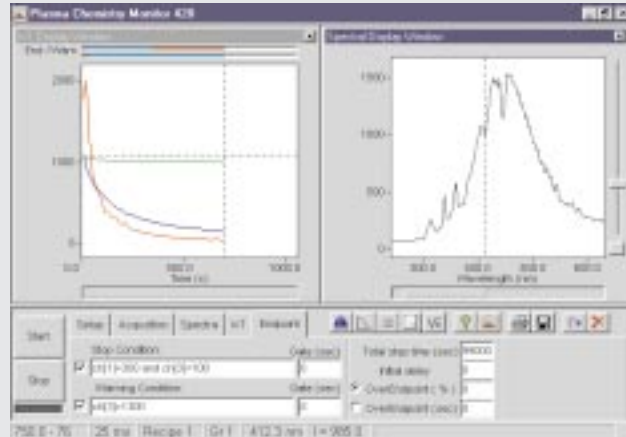


Software features

The PCM 420 uses Windows 95/98 software optimized for plasma diagnostics and process control. The graphic user interface is remarkably simple and intuitive, ensuring a short learning curve. Even personnel with no previous knowledge of spectroscopy can use the instrument within a few hours of instruction.

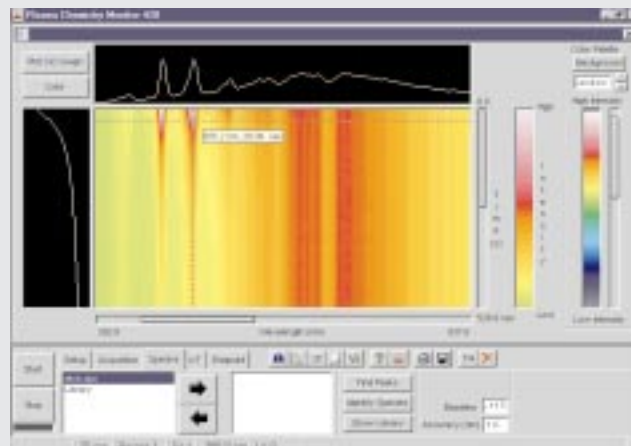
The **ProLight** software runs the hardware and basic data acquisition.

- Recording spectra is transparent for the user, and just a few instrument programmable settings have to be optimized to obtain the best data.
- Synchronization is easy using optical and electrical triggers. An optical trigger detects the process start point by checking light intensity variations in the chamber.
- Spectra are processed in 25 ms or less. Endpoint and intensity equations are evaluated at the same time data are acquired, ensuring correct and fast response by the PCM 420. Real-time spectra normalization, background subtraction and FFT filtering are implemented as well.
- Warning situations and endpoints are communicated using the programmable digital and analog outputs. A new remote operation mode via RS-232 takes further the system automation and facilitates integration with other instruments.
- Automated wavelength calibration and detector linearization routines make possible reproducible high quality data every time.



The **PlasmaPak** module provides chemical analysis and endpoint processing

- Sophisticated spectra visualization is accomplished with several display modes: Overlaid spectra, color coded contour maps and movie-like playback for spectra time series. Those visualization tools permit the easy localization of changes in plasma emission.
- Automated identification of plasma species is possible using the patented PCM 420 Spectral Library. Knowing the plasma species helps to develop sound endpoint algorithms and detect impurities during chamber qualification and troubleshooting.
- Endpoint algorithms and intensity functions are easily built in the equation editor. Wavelength functions support simple operators (*, +, -, /) and more complicated derivatives and areas. Endpoint algorithms include boolean logic as well. The combination of these operators, all available in a mouse click, generates powerful, intuitive and accurate equations. The equations output stability is optionally enhanced by digital filters.
- SQL compatible databases organize efficiently all the critical information related to the PCM 420:
 - Instrument settings in single and multi-step recipes
 - Equations and endpoints algorithms
 - Endpoint results datalogging
 - Security access control if needed
- Fully featured data file manager: Spectra are saved in convenient file formats (binary or comma delimited text), easy to use across spreadsheets and presentation software.

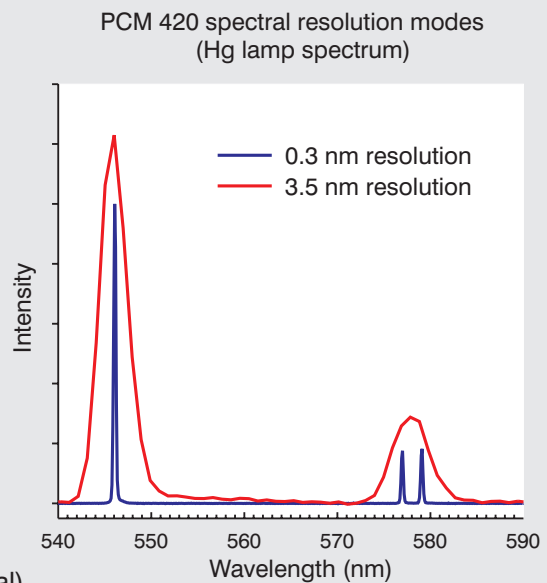


PCM 420 Advantages

- Portable, easy-to-use, turn-key hardware.
- Automated identification of plasma species
- Sophisticated endpoint algorithms.
- High light detection sensitivity and spectral resolution
- Fast spectra acquisition and data processing rates for real-time measurements.
- Integrated Windows software for data acquisition, process development and control.
- Remote control mode, external triggers and multiple I/O for process automation.

Specifications

- Double grating spectrograph
- Spectral resolution:
 - High resolution mode: 0.35 nm
 - Low resolution mode: 4 nm.
- Maximum wavelength error:
 - High resolution mode: 0.25 nm
 - Low resolution mode: 0.4 nm
- Detector: TE Cooled Back illuminated CCD array 1024x256 pixels
- Detector Quantum efficiency: 90% @ 600 nm
- High sensitivity range: 200-1000 nm
- Data acquisition: 16 bit, maximum rate: 40 Hz
- Linearity: 99.8%
- Signal-to-noise ratio: 3000:1
- I/O ports: digital input/output, analog output (optional).
- Fiberoptic: high UV-Visible transmission silica clad silica fibers.



Options

- User Specified Gratings
- Custom Fiber Optic Cables
- Mounts: Directional, Universal, LAM and Custom
- Probes: No lens, Standard, Elliptical and Custom
- Laptop Computer
- Transportation Cart



PCM 420
Directional Probe attached
to chamber using the
Universal Mount