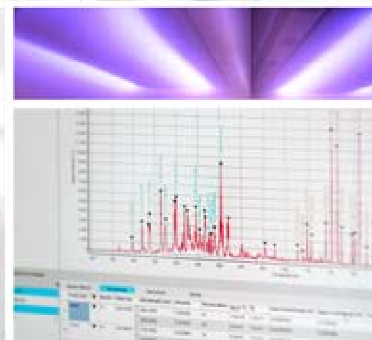
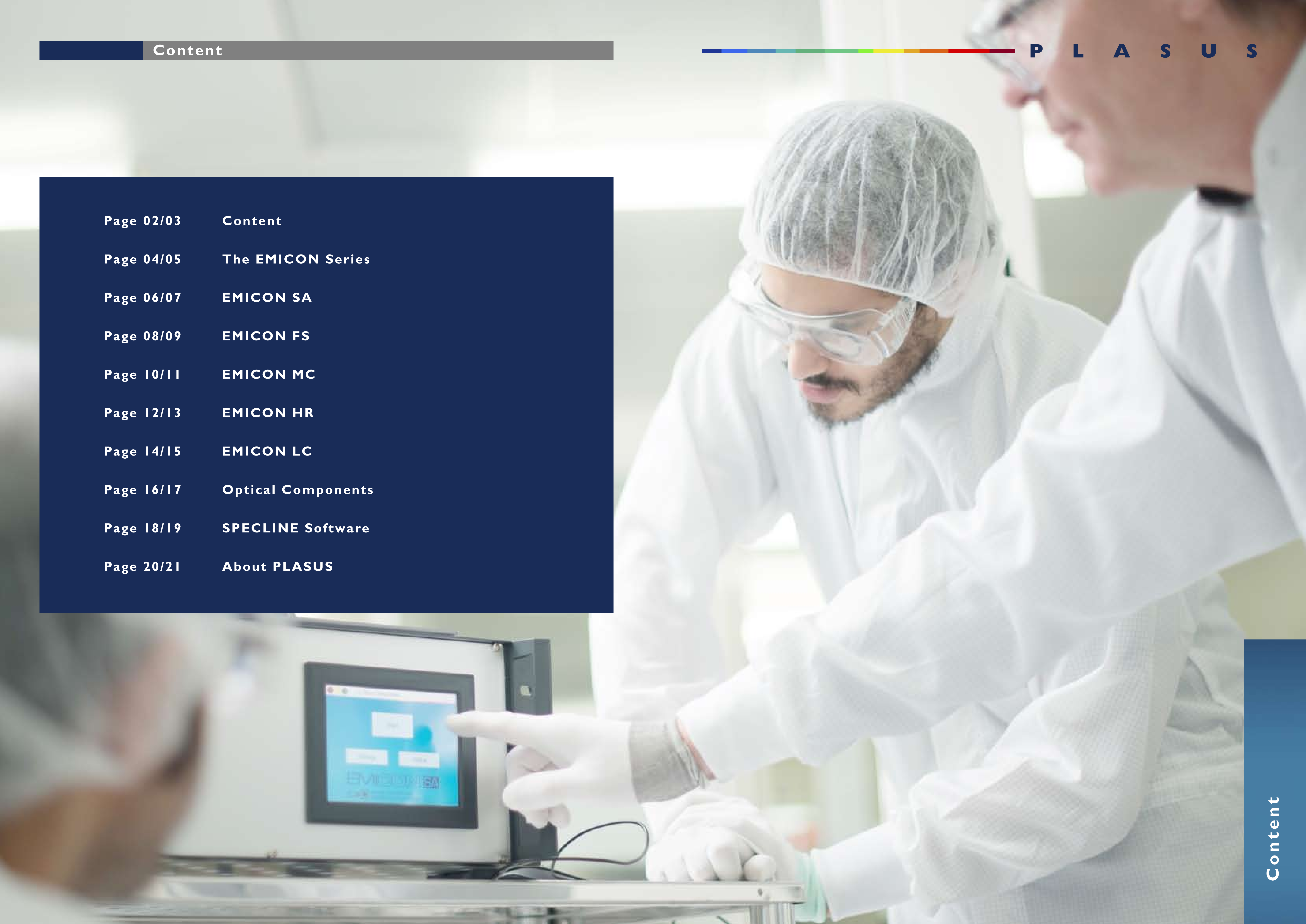
P L A S U S

PLASUS – SOLUTIONS FOR PLASMA MONITORING, SPECTROSCOPIC ANALYSIS & PROCESS CONTROL IN R&D AND INDUSTRY



SPECTROSCOPIC PLASMA MONITOR & PROCESS CONTROL SYSTEMS

WWW.PLASUS.DE



Page 02/03 Content

Page 04/05 The EMICON Series

Page 06/07 EMICON SA

Page 08/09 EMICON FS

Page 10/11 EMICON MC

Page 12/13 EMICON HR

Page 14/15 EMICON LC

Page 16/17 Optical Components

Page 18/19 SPECLINE Software

Page 20/21 About PLASUS

EMICON systems are the first choice for comprehensive plasma monitoring and process control in R&D and production lines. Their unique technology of acquiring and combining all important process data in one system in real time makes the EMICON systems the worldwide benchmark for successful process control.

Data acquisition

The EMICON series features acquisition modules for various measurement data of modern plasma applications. The plasma emission module operates with fiber optic spectrometers that acquire continuously complete spectra of the plasma light emission from UV to NIR at high speed. The HIPIMS/Pulse module allows triggered sampling of voltage signals in the MHz range and the layer control module acquires reflectance and/or transmission spectra of growing films. In addition, signals from supplementary sensors can be fed in by analog voltage inputs.

Real time monitoring of plasma process parameters

From the acquired emission data, any number of plasma lines can be chosen whose intensities are observed and tracked simultaneously. This allows a continuous monitoring of the plasma condition and composition. The HIPIMS/Pulse module provides voltage and current values from pulse slices, e.g. the peak current of HIPIMS processes. The layer control module calculates the film thickness based on a broadband spectral fit or color values with respect to standard color spaces. All acquired data from the modules is derived in real time and can be displayed as function of time as so called monitor tracks and, thus, provides a comprehensive picture of the process status in real time.

Process analysis

All monitor track data as well as the module raw data can be stored for archiving and off-line analysis. The stored data can be reviewed with the EMICON software in the replay mode. In this way, in depth analysis of the plasma process can be carried out by reanalyzing the recorded raw data.

Process optimization

The high speed data acquisition and evaluation enables process monitoring in real-time. This capability represents an indispensable tool to optimize the plasma process by taking advantage of the instant system response on parameter changes.

Process control

Analog and digital outputs and inputs are available to output monitor track values as continuous or threshold signals. The integrated PID control function enables closed loop control, e.g. for active gas flow or power control in reactive sputtering applications. Various mathematical and logical operators can be applied to the monitor tracks. These features allow sophisticated endpoint strategies and the detection of deviations from the expected plasma process conditions.

Advanced system software and system integration

The EMICON systems are operated and configured by an intuitive graphical user interface. The configuration of the software is highly flexible to focus on the relevant data and to display a comprehensive status of the specific process at a glance. All settings can be stored to and retrieved from recipes.

For system integration several fieldbus types are supported and a comprehensive subset of functionalities is available as API for integration in customer specific Windows and Linux applications.

The EMICON Series

The **EMICON SA** system has been developed especially for process control and quality assurance of industrial plants and production. The integrated processor unit allows 24/7 stand-alone operation. Several industrial fieldbus types as well as a proprietary programming interface are available to facilitate easy integration of the system into production lines.

Typical applications	Architectural glass, decorative coatings, solar cells
Customer base	Industry, production lines
Operation type	Stand-alone system with Linux based processor unit Real-time process monitoring and control Recipe based configuration
Spectral sensor	Broadband spectrometer 200 - 1100 nm (1-8 channels)
Layer control sensor	Spectral photometric measurement (1-8 channels)
External sensors	Analog input 0-10V (2/4 channels)
Trigger inputs	TTL/24V & optical (1 channel)
Sampling time	10 ms to minutes
Exposure time	55 µs to seconds
Monitor tracks	Spectral intensities, layer properties, external sensor
Controlling	Closed loop control (PID), endpoint detection by combining setpoints
User Interface	EMICON SA Manager software for Windows 7/10/11 via 1 GBit LAN (TCP/IP)
Data storage	Monitor tracks, emission spectra, layer spectra, external sensor signals stored on Windows computer
Fieldbus integration	Profibus, Profinet, EtherCAT, EtherNET/IP
Customized integration	LAN API (Windows DLL, Linux SO)
Analog control outputs	0-10V (4/8 channels)
Digital controls	TTL/24V (8 in & 8 out channels)
Housing	19” rack box (4U, 84HP)
Display	5.7” touch screen panel
Dimensions	480mm(w) x 190mm(h) x 420mm(d)
Weight	7.5 kg
Power supply	24VDC 2A

EMICON FS

PLASMA MONITOR AND PROCESS CONTROL SYSTEM

The EMICON FS system is a fast spectrocopic and electrical plasma monitor system that enables continuous pulse-resolved process monitoring and control in pulsed plasma applications like HIPIMS or pulsed-DC. With its unprecedented time resolution the EMICON FS system sets new and worldwide unique standards in industrial process control.

Typical applications	Hard coatings, optical coatings
Customer base	Industrial development, production lines, research institues
Operation type	Stand-alone system with Linux based processor unit Real-time process monitoring and control Recipe based configuration
Spectral sensor	Broadband spectrometer 200 - 1100 nm (1-8 channels)
HIPIMS/Pulse sensor	High-speed voltage input (±10V, 40MHz, 2 channels)
External sensors	Analog input 0-10V (2/4 channels)
Trigger inputs	TTL/24V & optical (1 channel)
Sampling time	250 µs to minutes
Exposure time	5.4 µs to seconds
Monitor tracks	Spectral intensities, pulse voltage/current, external sensor
Controlling	Closed loop control (PID), endpoint detection by combining setpoints
User Interface	EMICON FS Manager software for Windows 7/10/11 via 1 GBit LAN (TCP/IP)
Data storage	Monitor tracks, emission spectra, pulse curves, external sensor signals stored on Windows computer
Fieldbus integration	Profibus, Profinet, EtherCAT, EtherNET/IP
Customized integration	LAN API (Windows DLL, Linux SO)
Analog control outputs	0-10V (4/8 channels)
Digital controls	TTL/24V (8 in & 8 out channels)
Housing	19” rack box (4U, 84HP)
Display	5.7” touch screen panel
Dimensions	480mm(w) x 190mm(h) x 420mm(d)
Weight	7.5 kg
Power supply	24 VDC 2A

EMICON MC

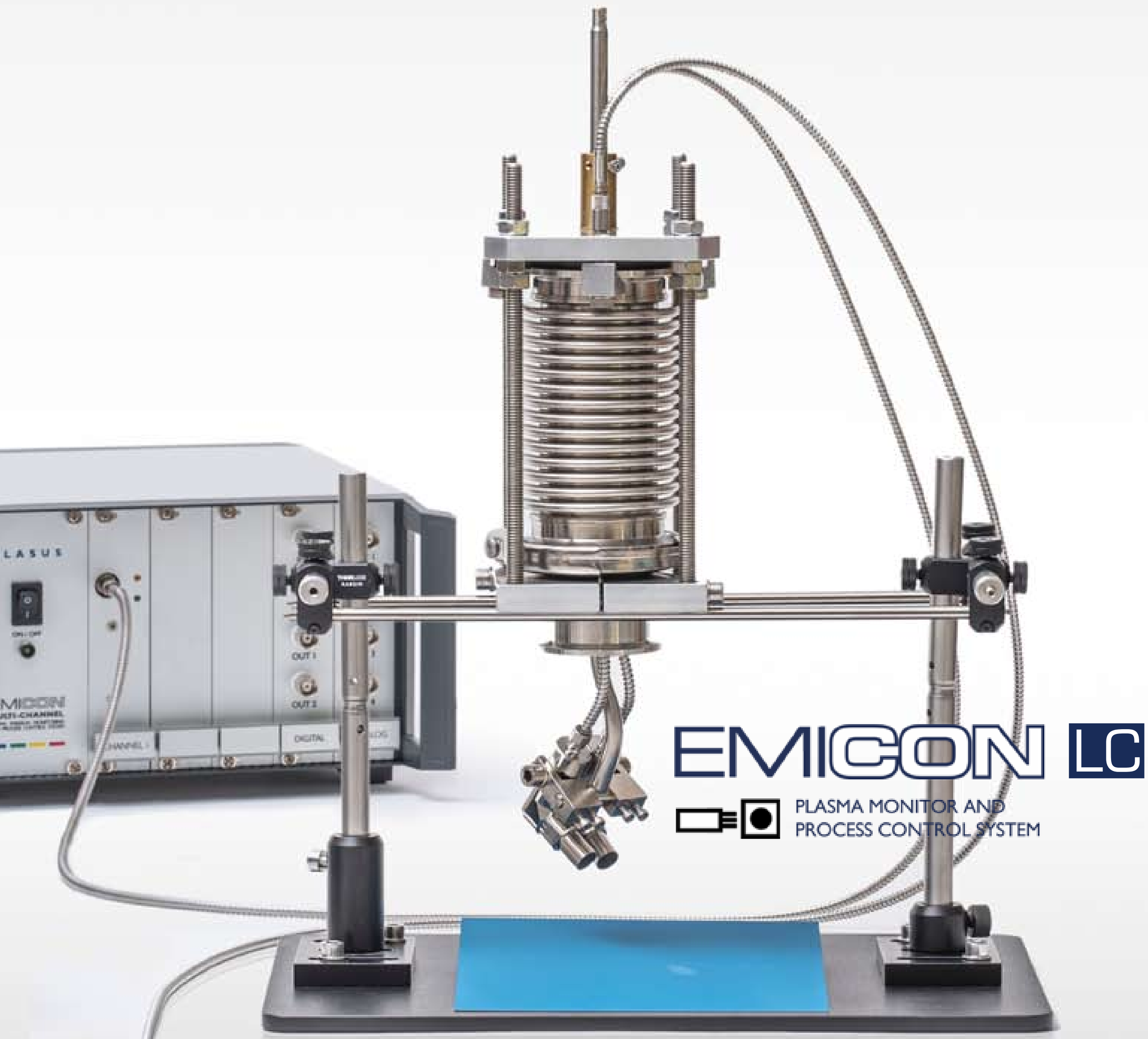
PLASMA MONITOR AND
PROCESS CONTROL SYSTEM

The EMICON MC system is an ideal plasma monitor system for R&D and suitable for almost any application in plasma technology for plasma analysis, plasma monitoring and process optimization. The modular EMICON MC systems can be equipped with all necessary features to observe, analyze and optimize typical technical and scientific plasma applications.

Typical applications	Sputter applications, PECVD, etching, atmospheric plasmas
Customer base	Universities, research institutes, industrial development
Operation type	Operation by external Windows computer Spectral analysis & real-time monitoring/control Recipe based configuration
Spectral sensor	Broadband spectrometer 200 - 1100 nm (1-8 channels) Spectral resolution FWHM 1.5 nm
Layer control sensor	Spectral photometric measurement (1-8 channels)
Sampling time	10 ms to minutes
Exposure time	55 µs to seconds
Monitor tracks	Spectral intensities, layer properties
Controlling	Closed loop control (PID), endpoint detection by combining setpoints
User interface	EMICON MC software for Windows 7/10/11 via USB 2.0
Data analysis	Real-time data evaluation and visualization, replay mode for post process analysis
Data storage	Monitor tracks, emission spectra, layer spectra
Analog control outputs	±10V (4/8 channels)
Digital controls	TTL (2 in & 2 out / 4 in & 4 out channels)
Housing	1-2 sensor modules: 10“ rack box (3U, 42HP) 3-8 sensor modules: 19“ rack box (3U, 84HP)
Dimensions	240mm(w) x 150mm(h) x 350mm(d) 480mm(w) x 150mm(h) x 350mm(d)
Weight	2.5-4.5 kg
Power supply	5VDC 5A

The EMICON HR system is a spectral high-resolution plasma monitor system and is particularly suitable for detailed spectral plasma analysis and for plasma monitoring. The higher spectral resolution of the EMICON HR enables a much better separation of adjacent atomic lines and the resolution of vibrational and rotational lines in molecular bands.

Typical applications	Plasmas containing molecules (e.g. RF, MW, DC driven PECVD)
Costumer base	Universities, research institutes, industrial development
Operation type	Operation by external Windows computer Spectral analysis & real-time monitoring Recipe based configuration
Spectral sensor	Broadband spectrometer 200 - 860 nm (1 channel) High spectral resolution FWHM 0.2 - 0.4 nm
Sampling time	50 ms to minutes
Exposure time	55 µs to seconds
Monitor tracks	Spectral intensities
User interface	EMICON MC software for Windows 7/10/11 via USB 2.0
Data analysis	Real-time data evaluation and visualization, replay mode for post process analysis
Data storage	Monitor tracks, emission spectra
Analog outputs	±10V (4 channels)
Digital controls	TTL (2 in & 2 out channels)
Housing	10" rack box (3U, 42HP)
Dimensions	240mm(w) x 150mm(h) x 350mm(d)
Weight	3.5 kg
Power supply	5VDC 5A



The **EMICON LC** system is an in-situ real-time photometric metrology system measuring reflection and transmission spectra of the surface exposed to the plasma process. From the spectral data film thickness and color properties are calculated. The system can also be integrated into the **EMICON SA** and **MC** systems, providing complementary information of the process product.

Typical applications	Architectural glass, optical and decorative coatings
Costumer base	Industry, universities, research institutes
Operation type	Operation by external Windows computer Reflection, transmission, absorption Recipe based configuration
Setup types	In-vacuum and ex-vacuum measurement In-situ and in-line operation
Spectral sensor	Broadband spectrometer 200 - 1100 nm (1-8 channels)
Light source	Halogen tungsten lamp stabilized, LED, laser driven Xe plasma
Sampling time	100 ms to minutes
Exposure time	55 µs to seconds
Monitor tracks	Reflection, transmission, absorption, layer thickness, color values, rms deviation
Data analysis	Real-time data evaluation and visualization, replay mode for post process analysis
User interface	EMICON LC software for Windows 7/10/11 via USB 2.0
Data storage	Monitor tracks, layer spectra
Substrate types	Transparent to opaque
Substrate surface	Planar & smooth
Film materials	Transparent with moderate absorption
Housing	10” rack box (3U, 42HP)
Dimensions	240mm(w) x 150mm(h) x 350mm(d)
Weight	4 kg
Power supply	5VDC 5A

Also available as integrated module to EMICON SA and EMICON MC system

VACUUMOPTICS

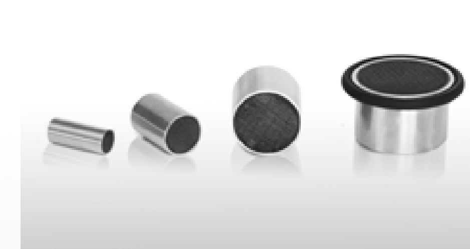
OPTICAL COMPONENTS FOR IN-VACUUM AND EX-VACUUM

PLASUS offers all optical components necessary for a complete measurement setup from the user application to the signal acquisition system. All components are optimized to transmit maximum light intensity while maintaining flexibility and durability in industrial environments. Sensors and fibers are available as in-vacuum and ex-vacuum models.

PLASUS provides a wide variety of optical components for in- and ex-vacuum use with different form factors to fit into any process environment even with space restrictions. All optical elements inside the components are made of fused silica to ensure light transmission over the entire spectral range of 200 - 1100 nm. The sensor optics for in-vacuum feature a unique coating protection device to prevent contamination and coating of the quartz optics ensuring long maintenance intervals. Available housing materials are polymer, stainless steel and aluminum.

Slim and miniature in-vacuum optics with coating protection and optical fibers

Ex-vacuum collimator optics with optical fiber

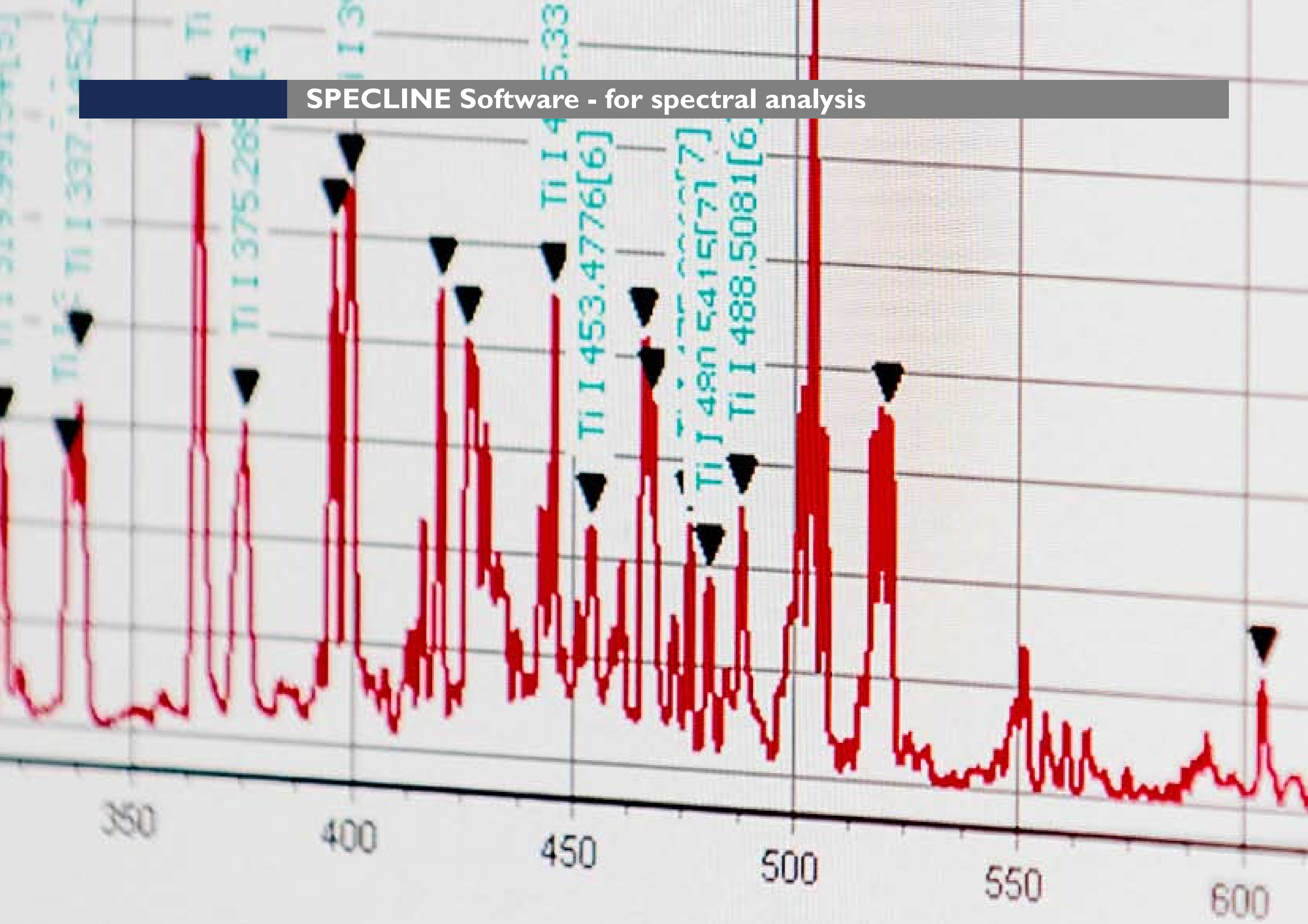


Coating protection devices in different diameters for KF flanges and other view ports

KF and CF flanges with up to 4 optical vacuum feedthroughs

Assembled in-vacuum fiber optics set

In-vacuum optic mounted to KF flange



SPECLINE
SPECTRAL LINE IDENTIFICATION FOR ATOMS AND MOLECULES

PLASUS SPECLINE is a powerful software package for the evaluation of spectral data. It includes a worldwide unique and up-to-date database for atoms, molecules and their ions. With the intuitive user interface spectral lines and molecular bands can be identified by a few mouse clicks. All common spectroscopic data formats are supported.

Line identification

Identification of atoms, molecules and their ions using the included database
Automatic peak finding
Search algorithms for peak finding in the spectra
Comparison of measured data
Several spectra - even with different file formats - can be overlaid and compared in a single session
Data filtering
Data smoothing, integral, scaling, peak value, calibration, arithmetic of spectra (+,-,*, /)
Intuitive user experience
Clearly structured layout, easy file handling, straightforward parameter configuration, well-structured and convenient usage

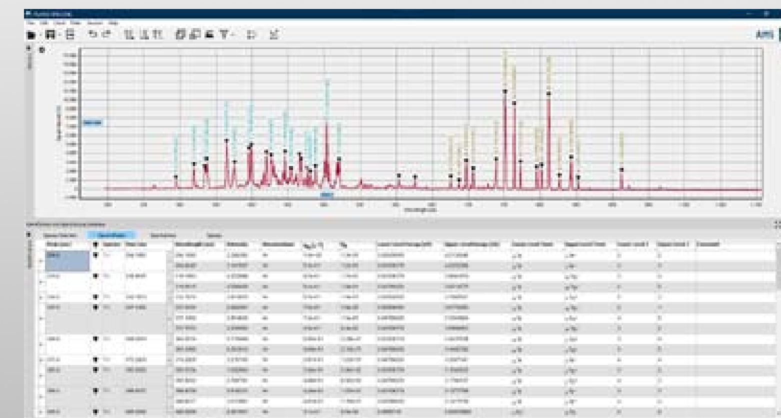
Database packages

A: atoms and ions
AM: atoms, ions and most two-atomic molecules
AMS: all available atoms, molecules and ions
User database add-on
Database for including private spectral lines and species (atoms, ions, molecules)
Interactive database tables
Display and handling of data in user defined tables: waverlength, oscillator strength, designation, transition probabilities, energies, quantum number and more

SpecLine file format

File format containing session, spectrum as well as identification data
Data import
Data import formats: ASCII, Binary, EMICON, AvaSoft, Ocean Optics, WinSpec, Hamamatsu, GRAMS, 4SPEC, MAPS, DaVis and more
Data export
Data export to ASCII, Binary and Excel (CSV) format, graphic export to JPG, PNG, GIF and BMP format

SPECLINE software for Windows 7 / 10 / 11



PLASUS

PLASUS GmbH is a worldwide leading manufacturer of spectroscopic process monitor and control systems for plasma processes in R&D and industry.

Since 1996 PLASUS has been developing, producing and distributing innovative and application-oriented plasma monitor and process control systems. Applications range from quality control of PECVD plasmas, active process control in reactive sputtering processes and endpoint detection in etching processes to process monitoring of atmospheric plasmas.

From the very beginning, PLASUS put particular emphasis on the consistent application of spectroscopic measurement technology in a turnkey system suitable for industrial plasma processes. This results in cutting edge plasma monitor and process control systems with innovative optical sensors and a comprehensive yet easy-to-use software interface that provides users with a variety of novel real-time measurement techniques in plasma technology.

The experienced team of engineers and scientists develops and designs the PLASUS measurement systems, often in collaboration with renowned research institutes and leading edge industry customers. Final assembly is carried out exclusively at the headquarters in Mering, Germany to ensure high manufacturing standards and quality assurance.

All software products are developed and coded in-house which guarantees a seamless connection to the hardware components and maximizes the system performance. Also customer and market requirements can be realized in a flexible way.

The worldwide PLASUS distributor network consists of experienced sales and support partners in Europe, North America and many Asian countries especially Taiwan, Japan, China and Korea.

For further information please contact:

P L A S U S

Spectroscopic plasma monitor &
process control systems

PLASUS GmbH
Lechstrasse 9
D-86415 Mering
Germany

Tel.: +49 8233 73 53 78-0
Fax: +49 8233 73 53 78-9

E-Mail: service@plasus.de
Internet: www.plasus.de

All images are copyright material and may not be reproduced without permission. Copyright 2021 PLASUS GmbH, Germany