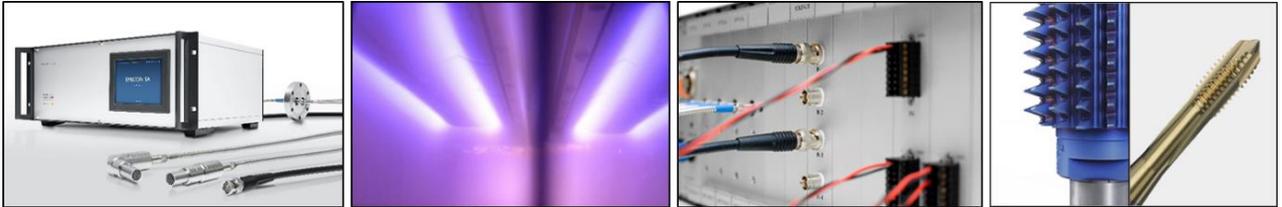
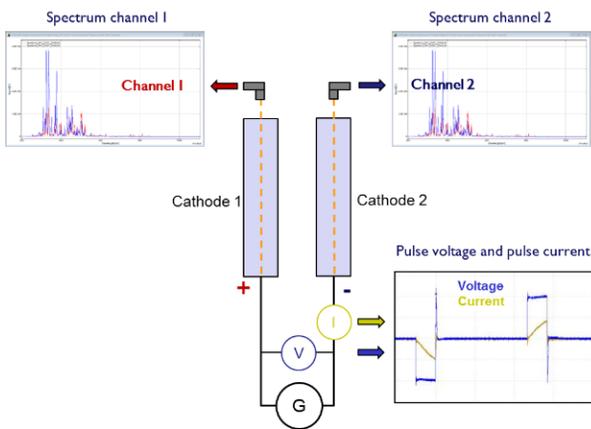


Full control of reactive pulse and HIPIMS processes with PLASUS EMICON SA-HIPIMS System

In pulse and HIPIMS plasmas the degree of ionization is one main factor for layer density while layer stoichiometry is ruled by the plasma composition of metal and reactive gas species. Changing either parameter will affect also the other parameter. Thus controlling both, degree of ionization as well as stoichiometry simultaneously can only be realized by combining different measuring and controlling methods.



The EMICON SA-HIPIMS system combines data acquisition of peak current and peak voltage with the spectroscopic plasma monitoring technique in a single system. All sensor signals are recorded continuously and are evaluated in a common control algorithm realizing reliable and stable process control of both plasma parameters.

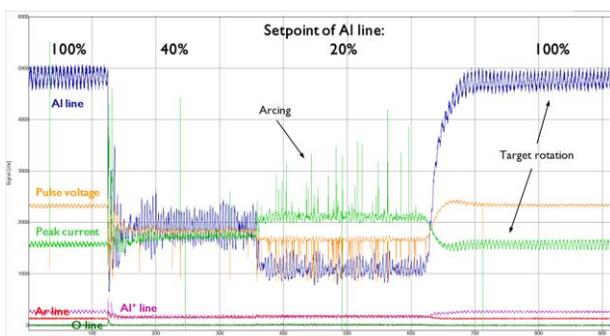
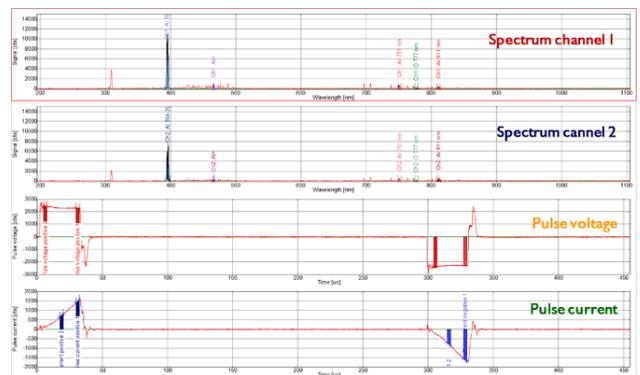


Signal selection:

- Multiple spectral lines
- Peak current and peak voltage
- Shape of current and voltage pulse
- Combined signals, e.g. +, -, /, *, ...

Sensor and measuring setup:

- Single or dual cathode application
- Full broadband spectral information of each cathode
- Pulse current and pulse voltage measurement
- Pulse triggered data acquisition

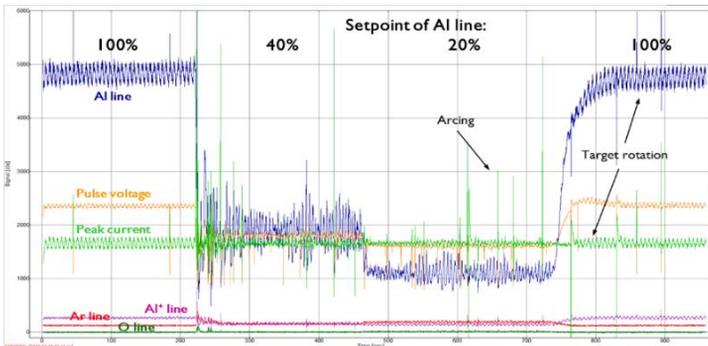


Process monitoring and control:

- Real-time monitoring of particle densities
- Recording of peak current and peak voltage
- Control of reactive gas flow
- Control of degree of ionization

Examples & Applications

AIO reactive HIPIMS unipolar:



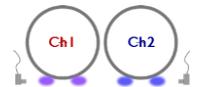
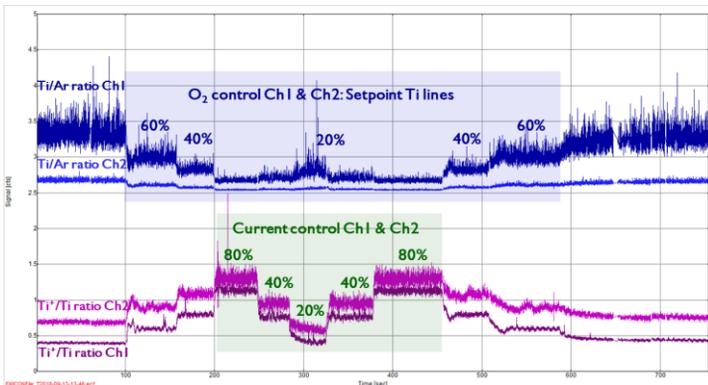
Application:

Control of oxygen flow with Al line
Control of pulse peak current using variable pulse-off times

Features:

Stable gas flow control despite target rotation and arcing
Pulse peak current increases with reactive gas flow
Pulse voltage decreases with reactive gas flow

TiO reactive HIPIMS bipolar:

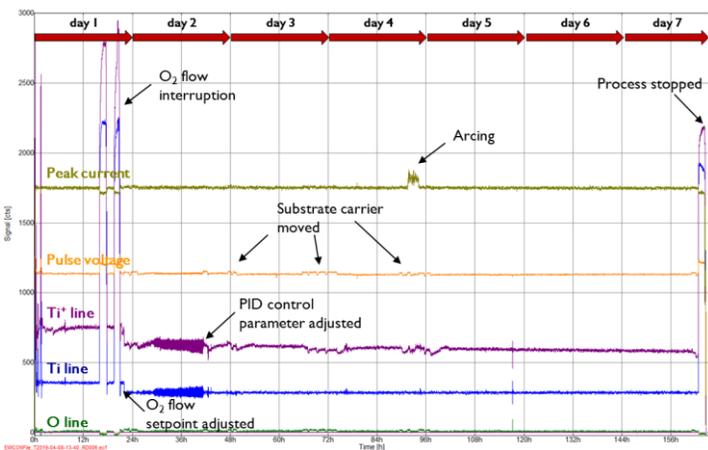


Application:

Control of oxygen flow with Ti line at both cathodes independently
Control of pulse peak current at power supply for both cathodes independently

Features:

Gas flow control holds setpoint while varying peak current at cathodes



Application:

Long-term control of reactive HIPIMS process (7 days)
Stable production process secured by simultaneous gas flow and peak current control

Features:

Independent control of stoichiometry (reactive gas flow) and ion density (peak current)
Balancing cathodes despite setup, target erosion, etc.

Perspectives for R&D and benefits for production

Combined real-time monitoring and controlling opens new opportunities for reactive high-density plasmas:

=> Control of working points which could not be controlled so far
(increased deposition rate, new or better layer properties, ...)

=> Long-term stabilization of production process by combined control techniques

(setting of power, voltage, current, pulse on-time, pulse off-time, different settings for \pm pulse in bipolar mode, ...)

Cooperation of:

