Characterization of a plasma with SEERS by a aluminium-etch

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	Klaus Reingruber	(CFE R PE2)
	Walter Preis	(CFE R PE2)
	Konrad Koller	(production)
	Markus Schardin	(disertation)
equipment:	AME 8330	512-222
	AME 8330	512-223
Data recording:	29.9.1999	(512-223)
	5.10.1999	(512-222)

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Equipment

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AME 8330

Advantage: U_{HF} directly from matchbox

Disadvantage: batch-tool

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Infineon technologies

The disertation

- Sensitivity from the sensor
- Interaction from plasma values
- Conection to the productiv lots
- future

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Sensivity from the Hercules-Sensors

Process values:
- Cl_2-gasflow
- BCL_3-gasflow
- CHF_3-gasflow
- RF-power
- pressure

Variation: up to +/- 50% from the standard value

Chamberload:
- mixed load (aluminium-/ resist-wafer)
- single load (only aluminium or resist wafer by the Cl_2 und BCl_3 experiments)

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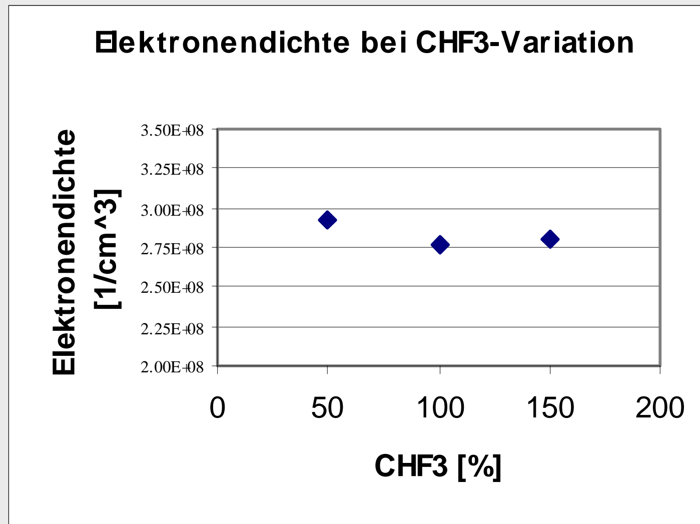
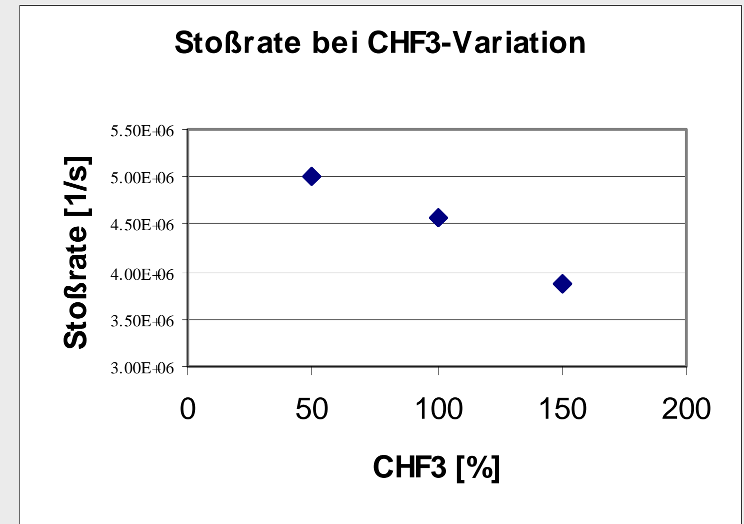
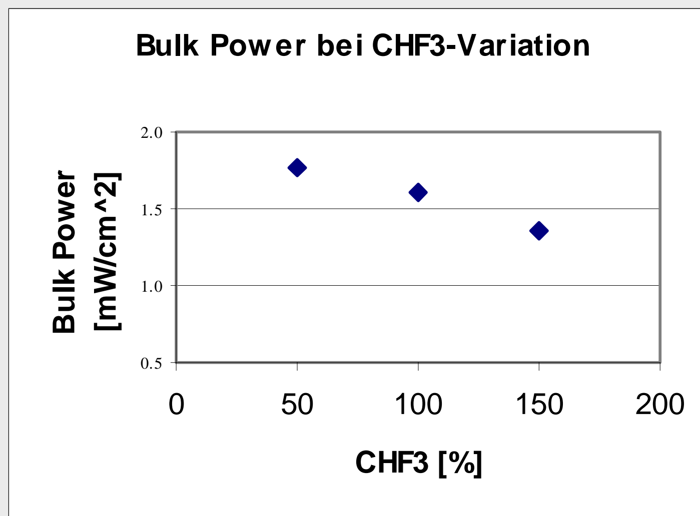
Sensivity from the Hercules-Sensors







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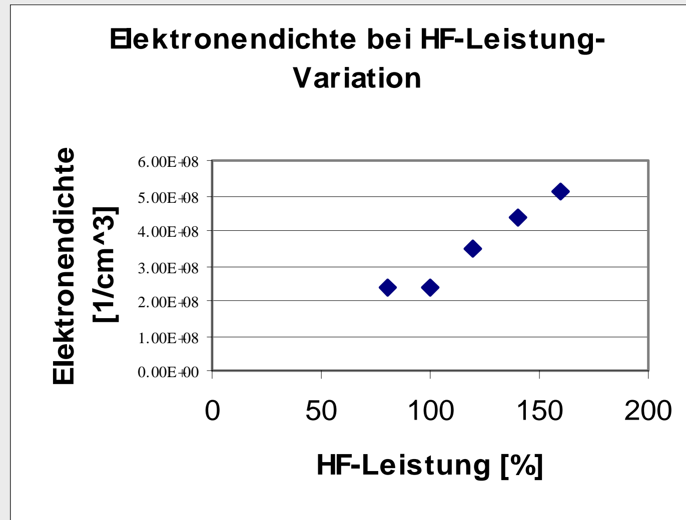
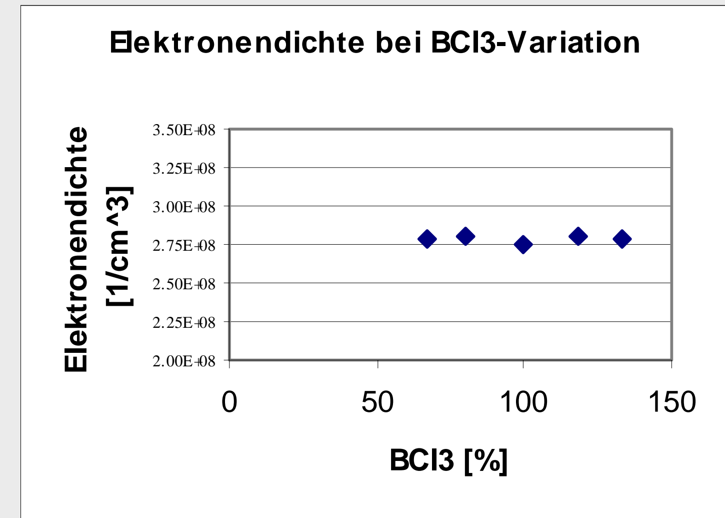
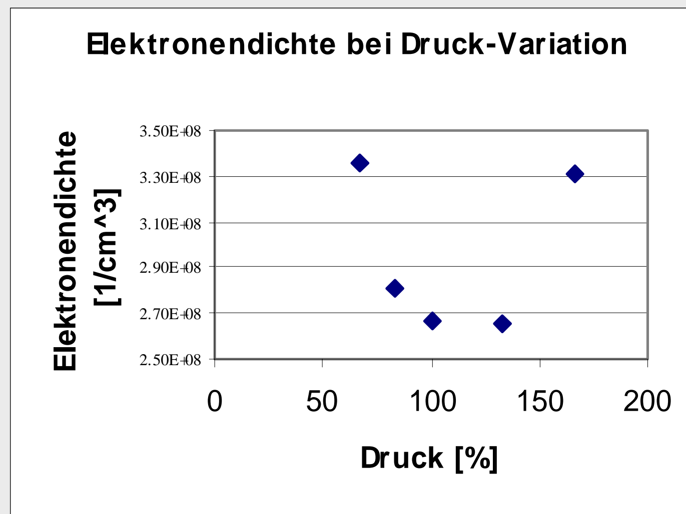
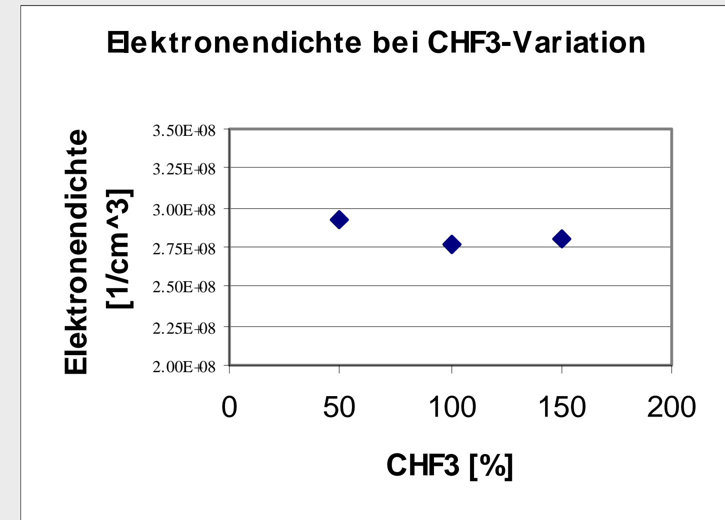
Sensivity from the Hercules-Sensors









Sensivity from the Hercules-Sensors

Collision rate:

$$\upsilon_{(r)} = \upsilon_{stoch} + \sqrt{\frac{8kT_e}{\pi m_e}} \frac{p}{kT_N} \sum_k \frac{p_k}{p_{ges}} q_k$$

In Summe gehen die Stoßquerschnitte aller Teilchen ein

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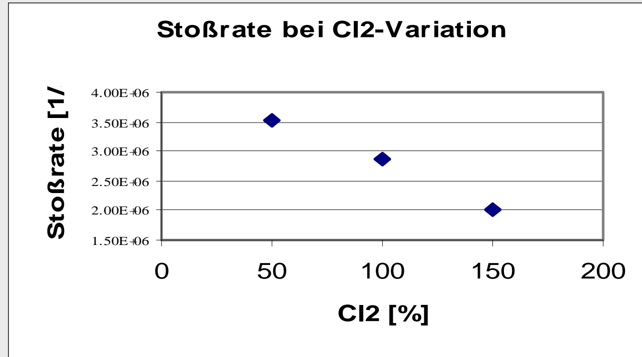
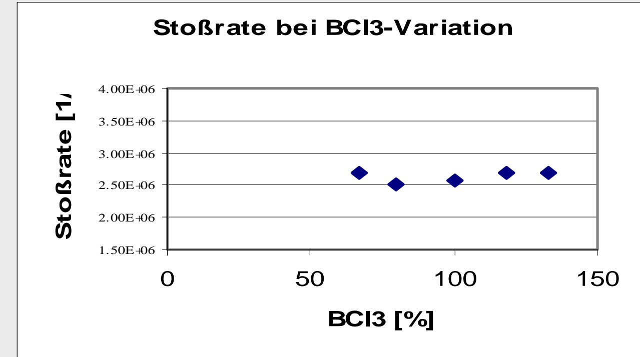
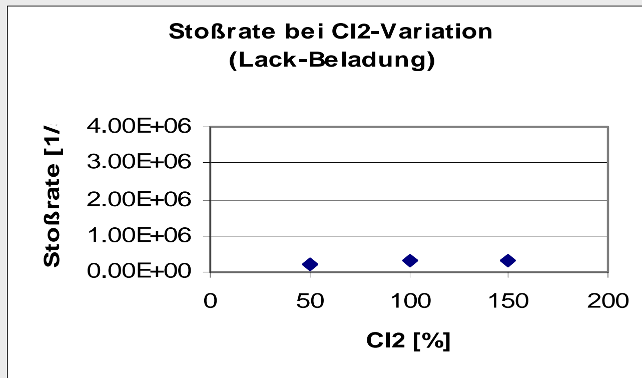
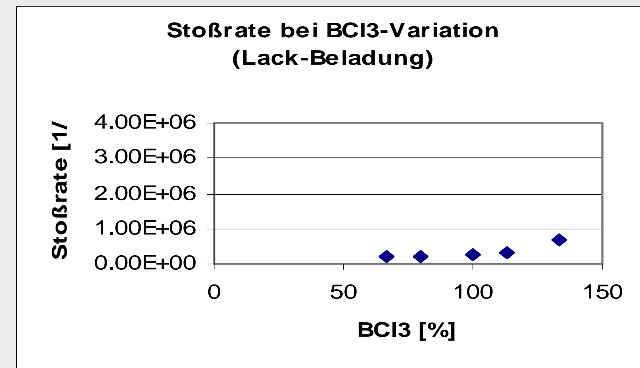
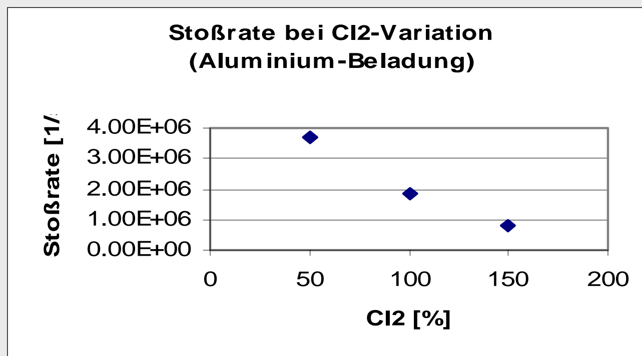
Sensivity from the Hercules-Sensors

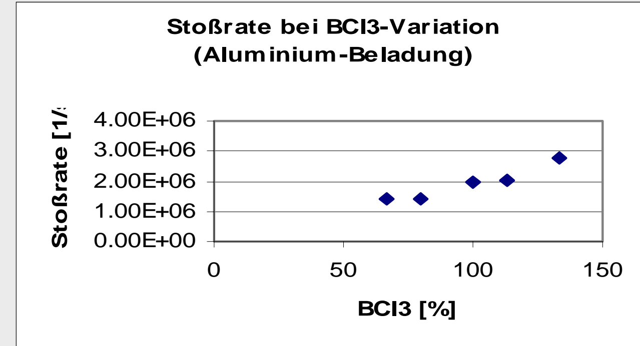












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Résumé
Sensivity from the Hercules-Sensors

Hercules values reactions:

- Collision rate and Bulk Power reacted good
- Electron density only by pressure and RF-Power important

Process values <--> Hercules values:

- Influence from the etch product (for example: $AlCl_3$) on the collision rate
- Cross section one reason ???

Interaction from plasma values

2^3 matrix

Process values / variation

- Bias-voltage (+/-15%)
- pressure (+/-25%)
- BCl_3 / Cl_2 gasflow-ratio (+/-25%)

Chamber load

Mixed load (aluminium-/ resist-wafer)

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Interaction from plasma values

Correlation from:

- electron density
- collision rate
- bulk power
- resist etch rate
- aluminium etch rate
- emission intensity (396nm)

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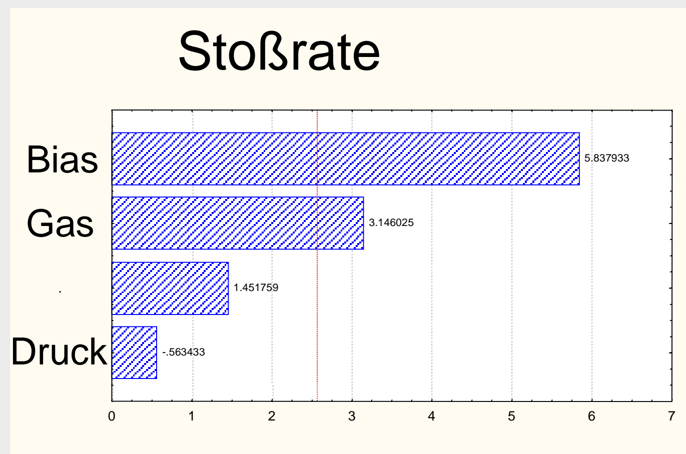
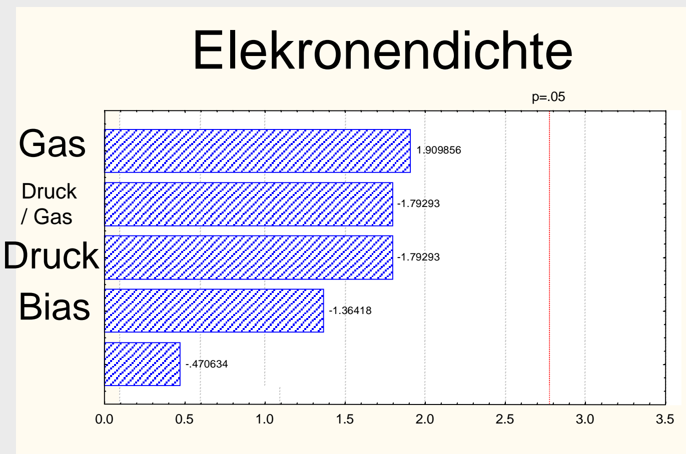
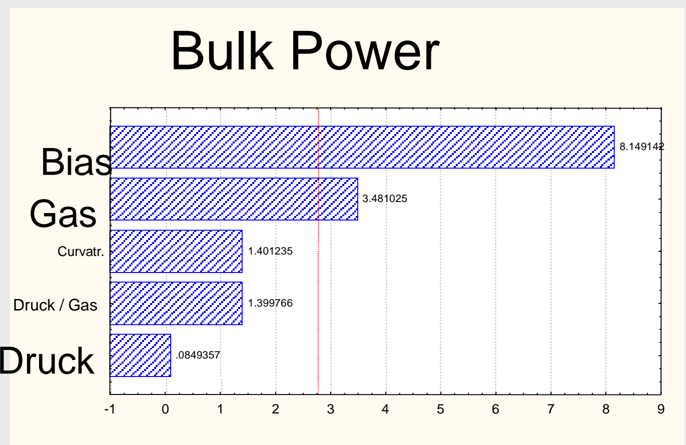
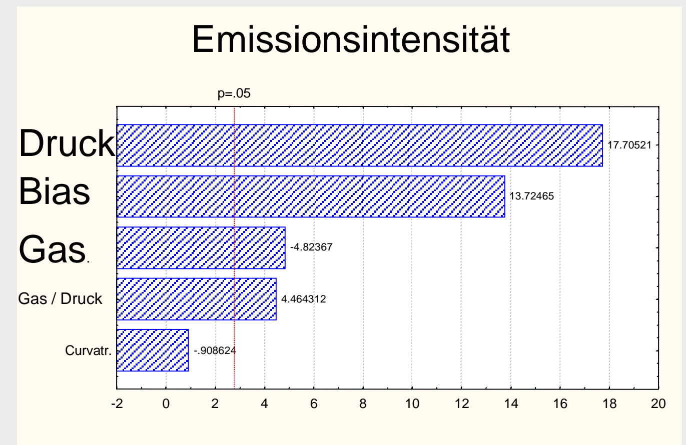
Interaction from plasma values









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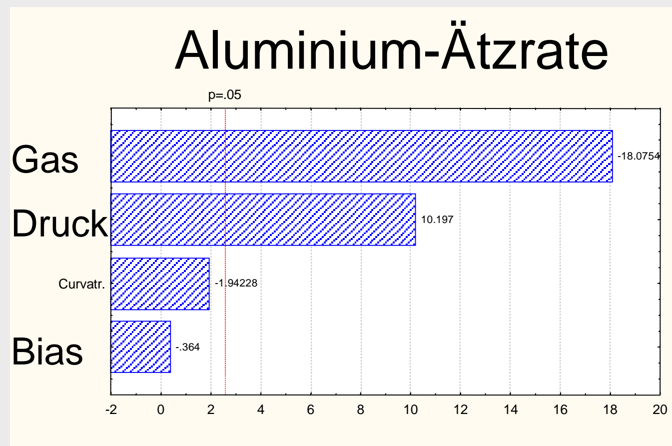
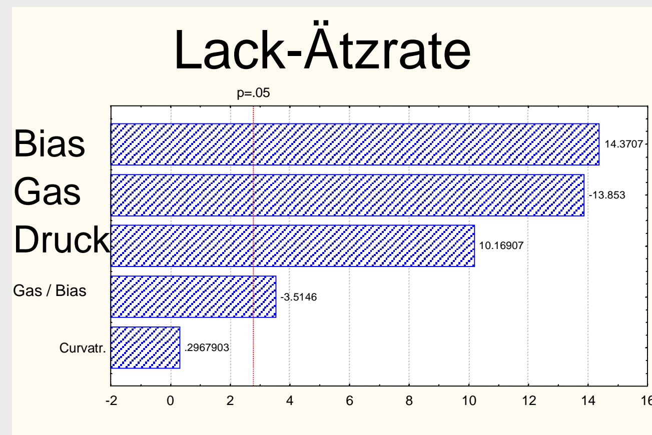
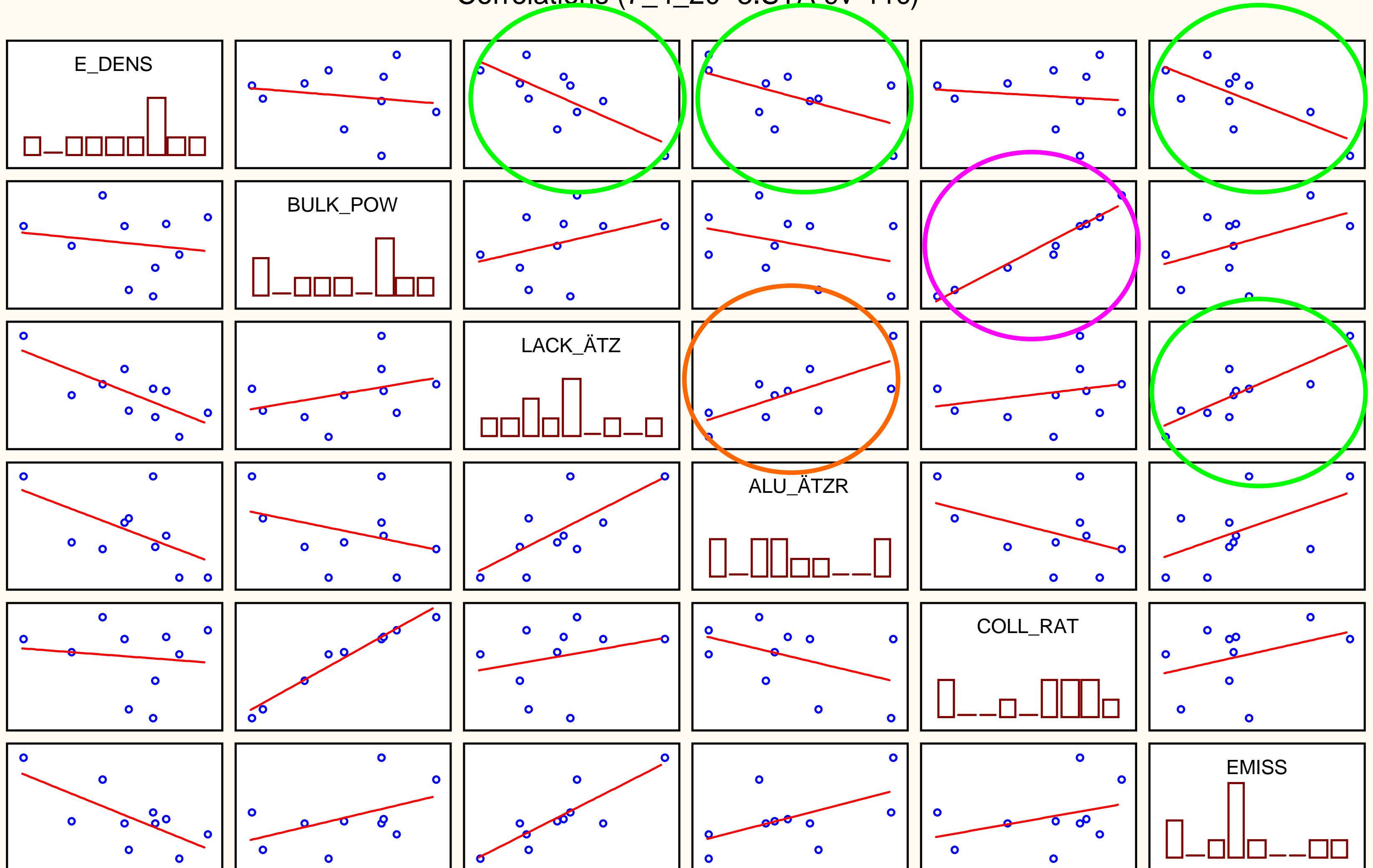
Interaction from plasma values

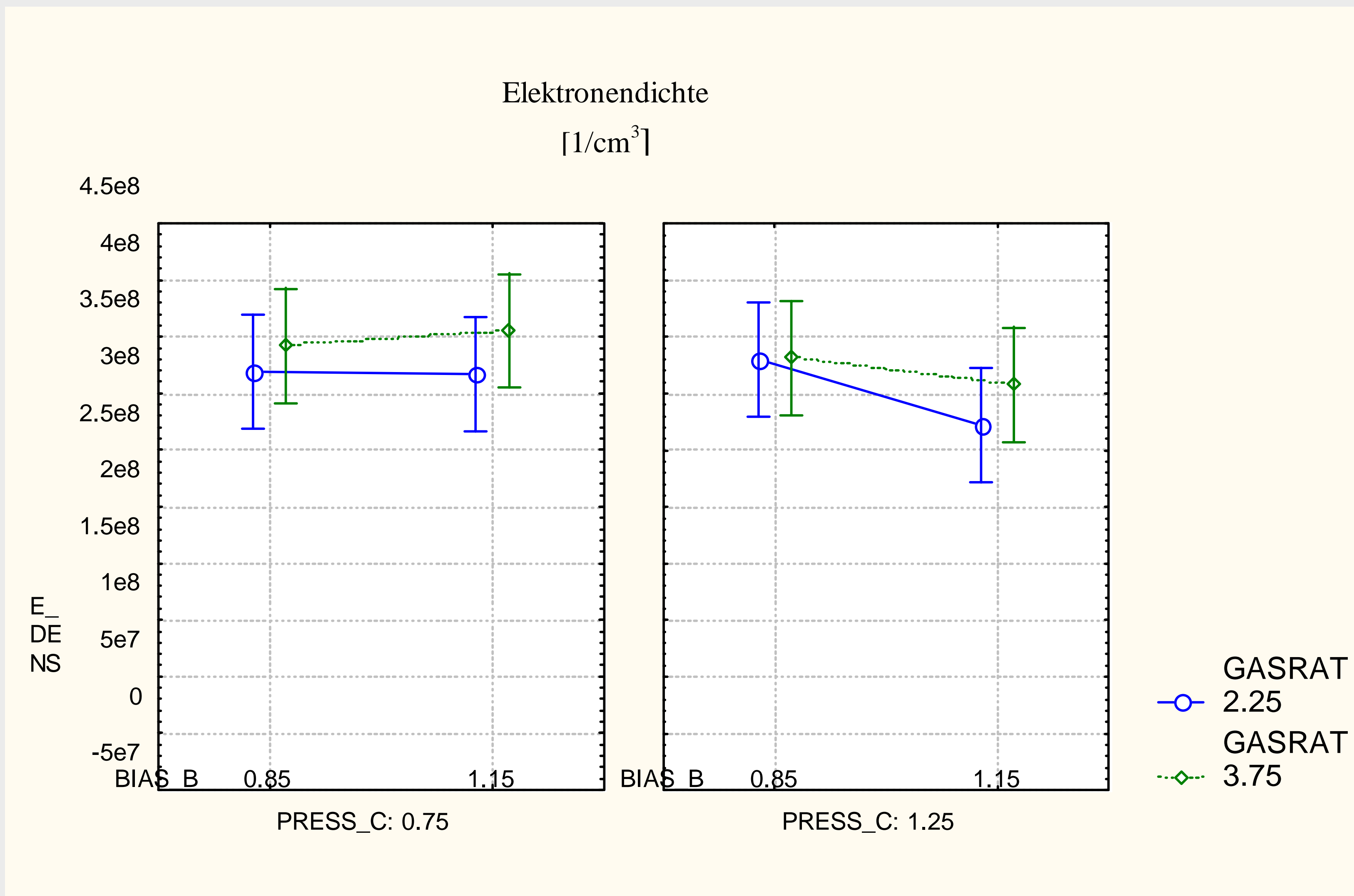




Interaction from plasma values



Interaction from plasma values



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Résumé
Interaction from plasma values

Matrix:

- Resist etch rate is very dependent from the bias-voltage
- Aluminium etch rate is independent from the bias-voltage

Correlation:

- Bulk Power and collision rate correlate nearly with 100%
- Electron density correlate with the emission intensity and the etch rates

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Effects

Experiments

Oszillation in the collision rate

Oszillation in the electron density

Jumps in the electron density

Productiv lots

Oszillation in the electron density

(sinus & rectangle)

Oszillation in the collision rate (rectangle)

Higher electron density

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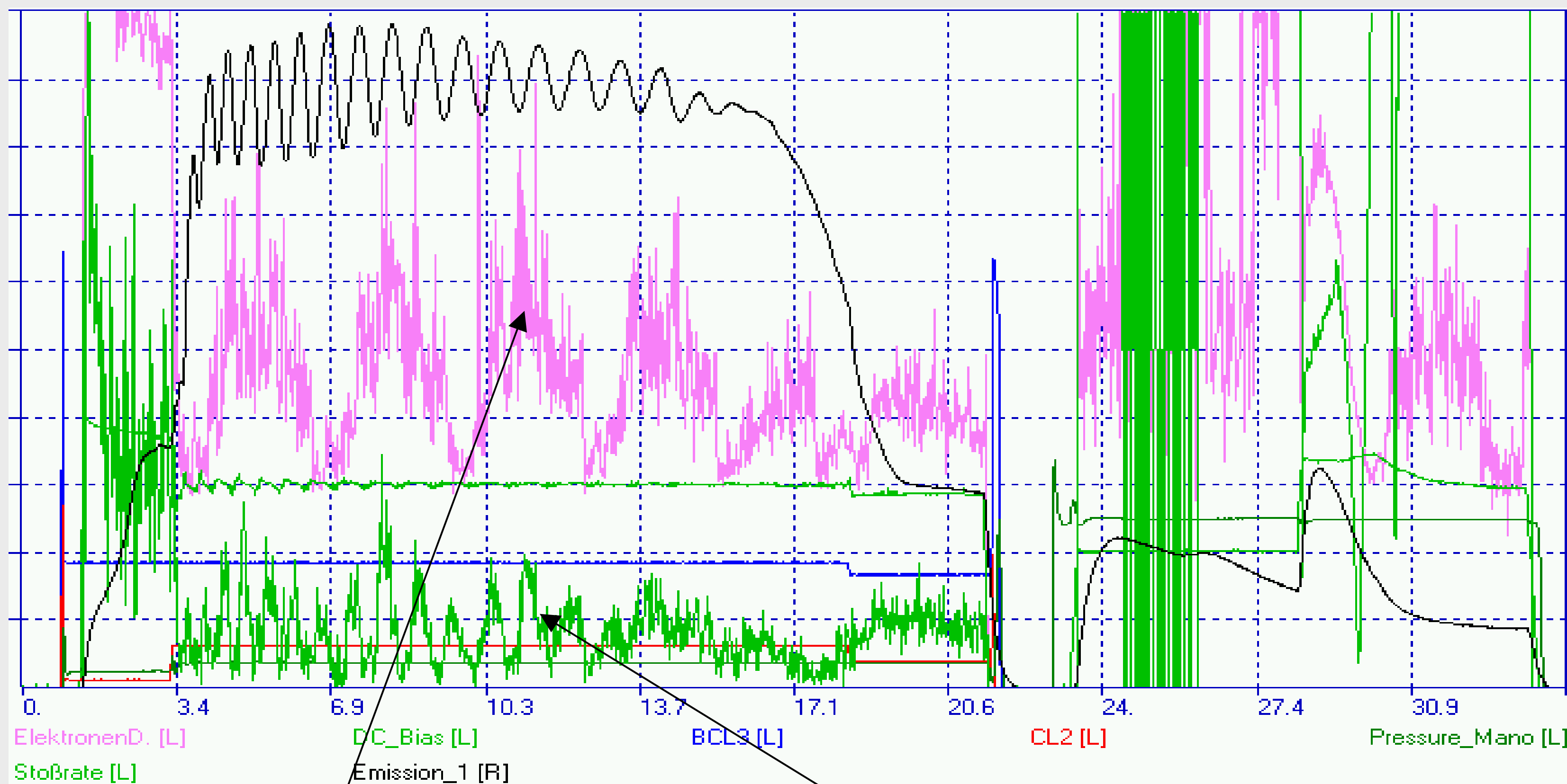
Oszillation in the electron density



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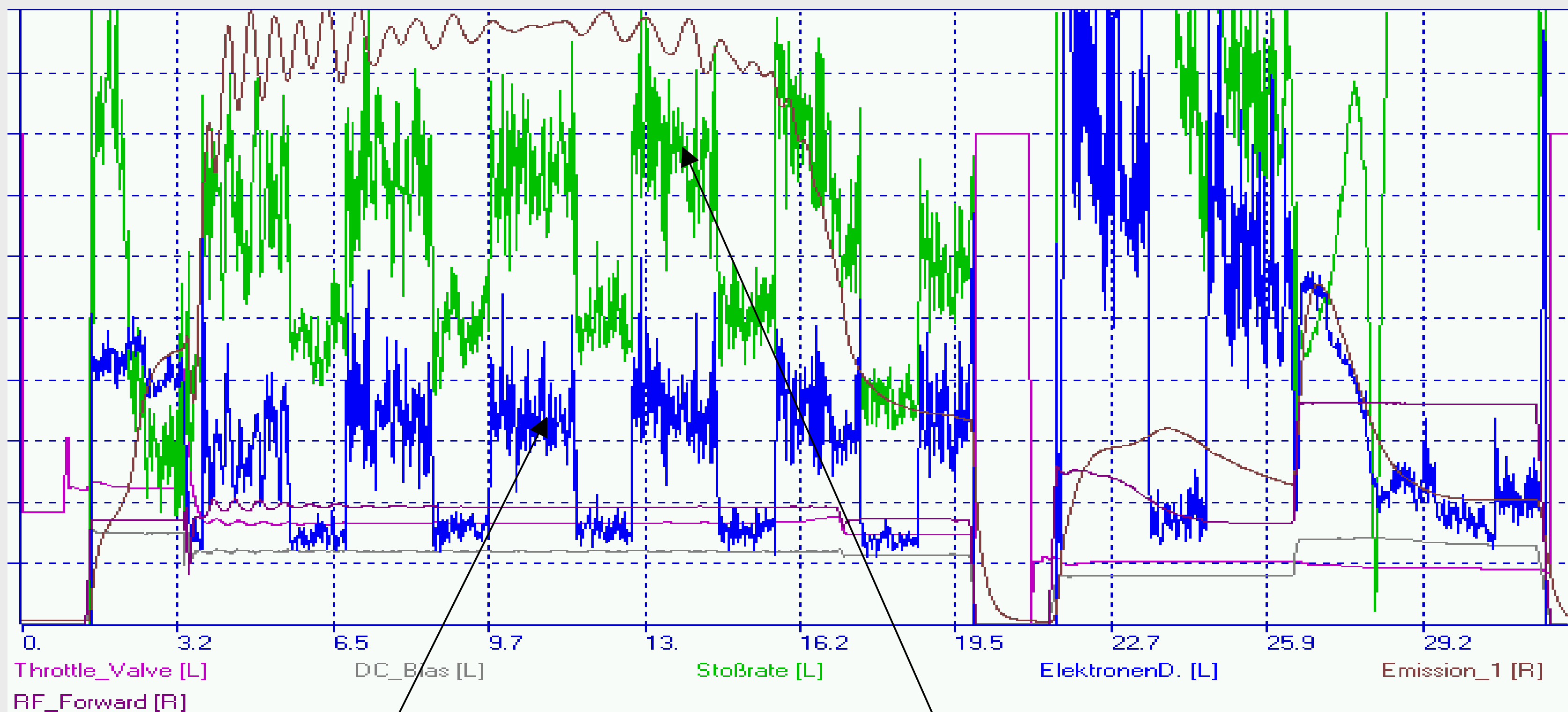
Oszillation in the electron density (rectangle)



Electron density

Collision rate

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Ausbeute- und PCM-Analysen

Ausbeute-Analysen

keine signifikanten Änderungen

PCM-Analysen

keine signifikanten Änderungen

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Résumé and the future for the Hercules sensor by the aluminium etch on the AME 8330

Short-term: online-process control not to realize

Difficulties to connect the values from the sensor

Difficulties to understand the values from the sensor

Medium-term: Connection from some values with the productive lots

for die plasma caracterisation very important equipment

Long-term: with or without other plasma values able to realize a online process control

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