enthone

Handling of IL´s in production Process

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IONMET Workshop, Munich, 24.03.2009

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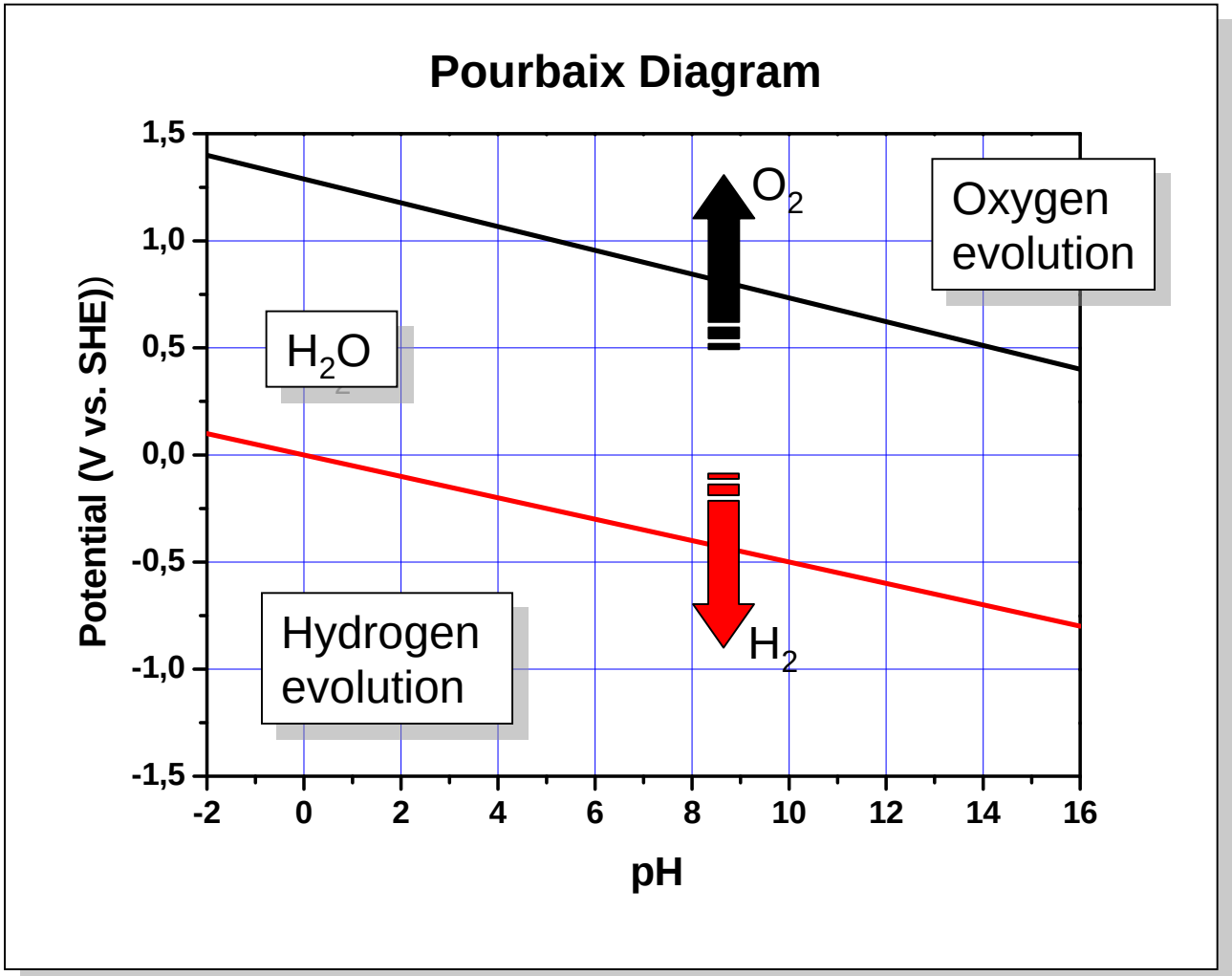
Limitations for electroplating in aqueous solution



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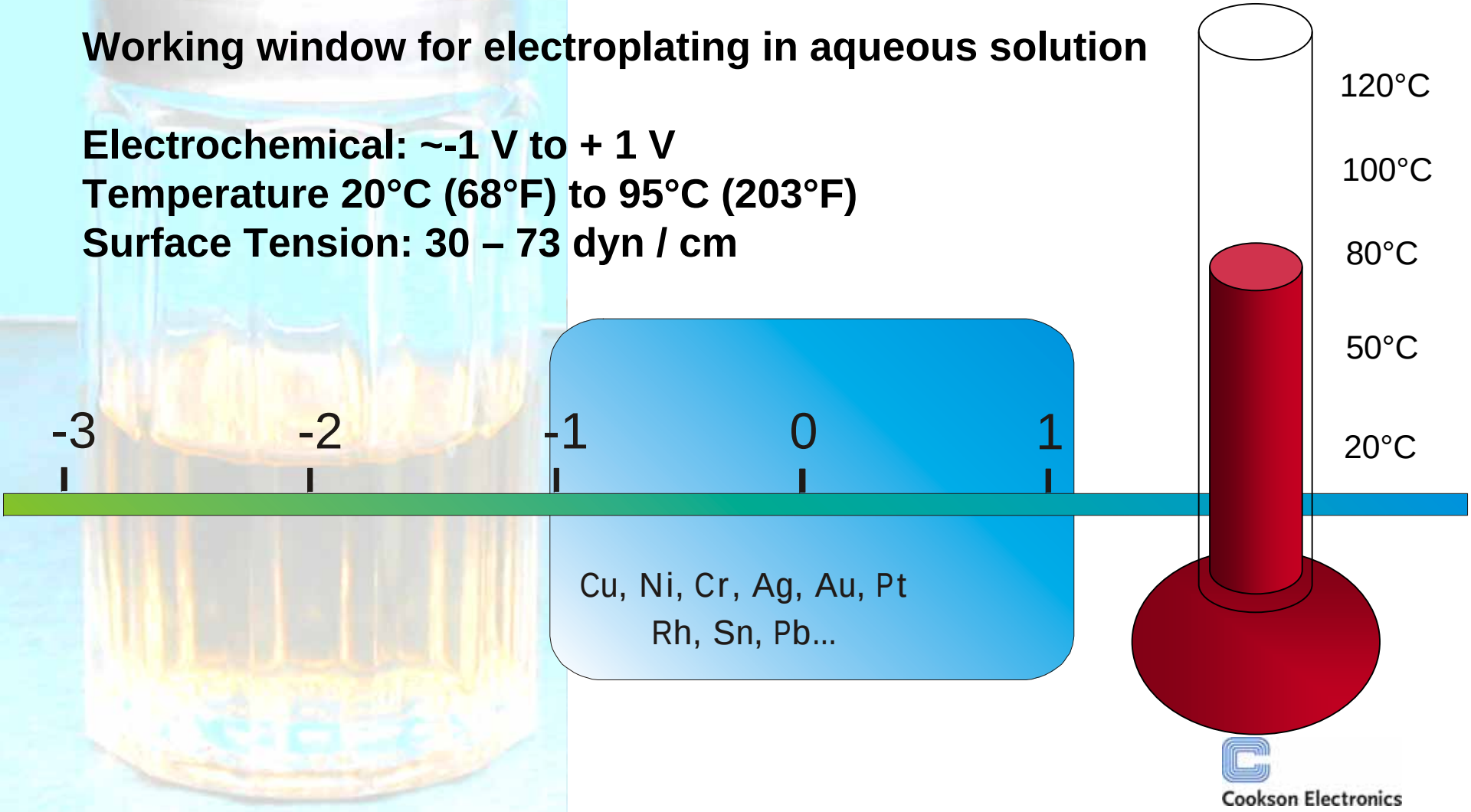
Ionic Liquids: Useful for electroplating?

Working window for electroplating in aqueous solution

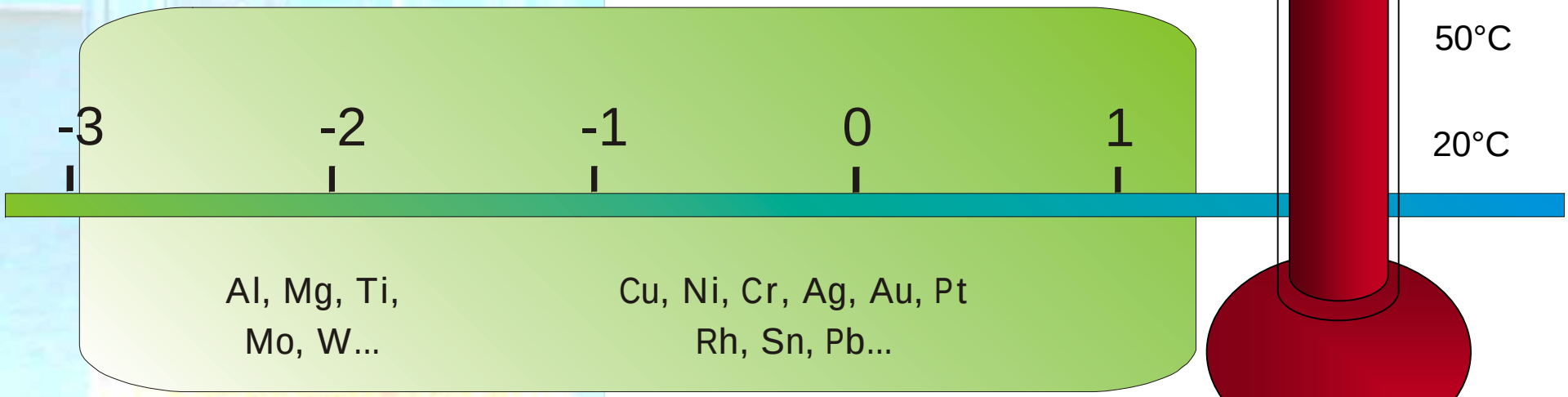
Electrochemical: ~-1 V to + 1 V
Temperature 20°C (68°F) to 95°C (203°F)
Surface Tension: 30 – 73 dyn / cm

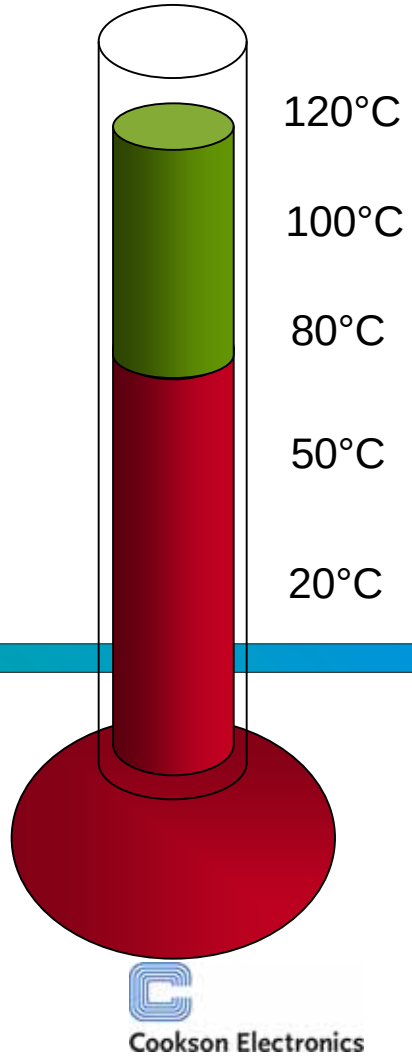


Ionic Liquids: Useful for electroplating?

Working window for electroplating in Ionic Liquid

Electrochemical: ~-3 V to + 1.5 V (or higher)
Temperature 20°C to 150°C
Surface Tension: < 30 dyn/cm





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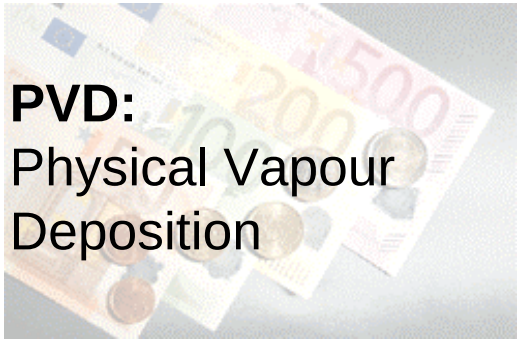
Example - Plating from Ionic Liquids: Aluminum

State of the art in Al deposition:



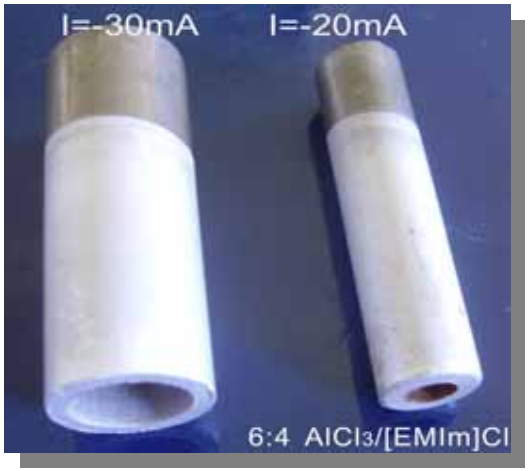
PVD:
Physical Vapour Deposition

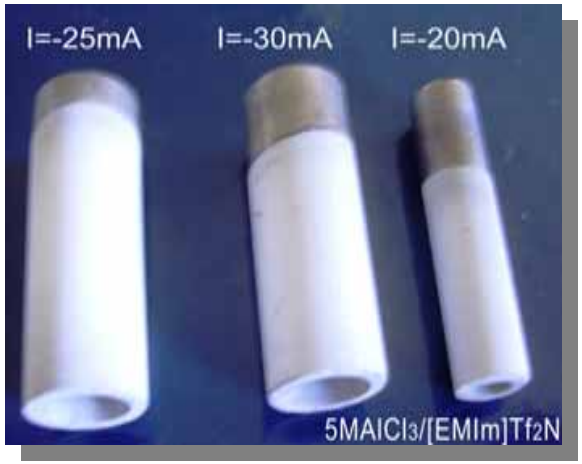
Aluminal Process:
Deposition of Aluminum from Trialkylaluminum & organic solvents

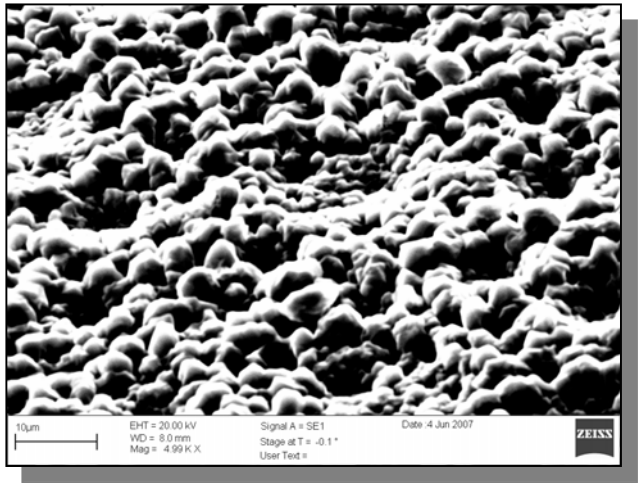
Audi A8 (Full Aluminum Car Body)

Plating from Ionic Liquids: Aluminum

Al deposit from IL-solution on steel pipes







$AlCl_3$/[EMIm]Cl mit 60% $AlCl_3$
$AlCl_3$/[EMIm]Tf_2N mit 5.5 mol/L $AlCl_3$

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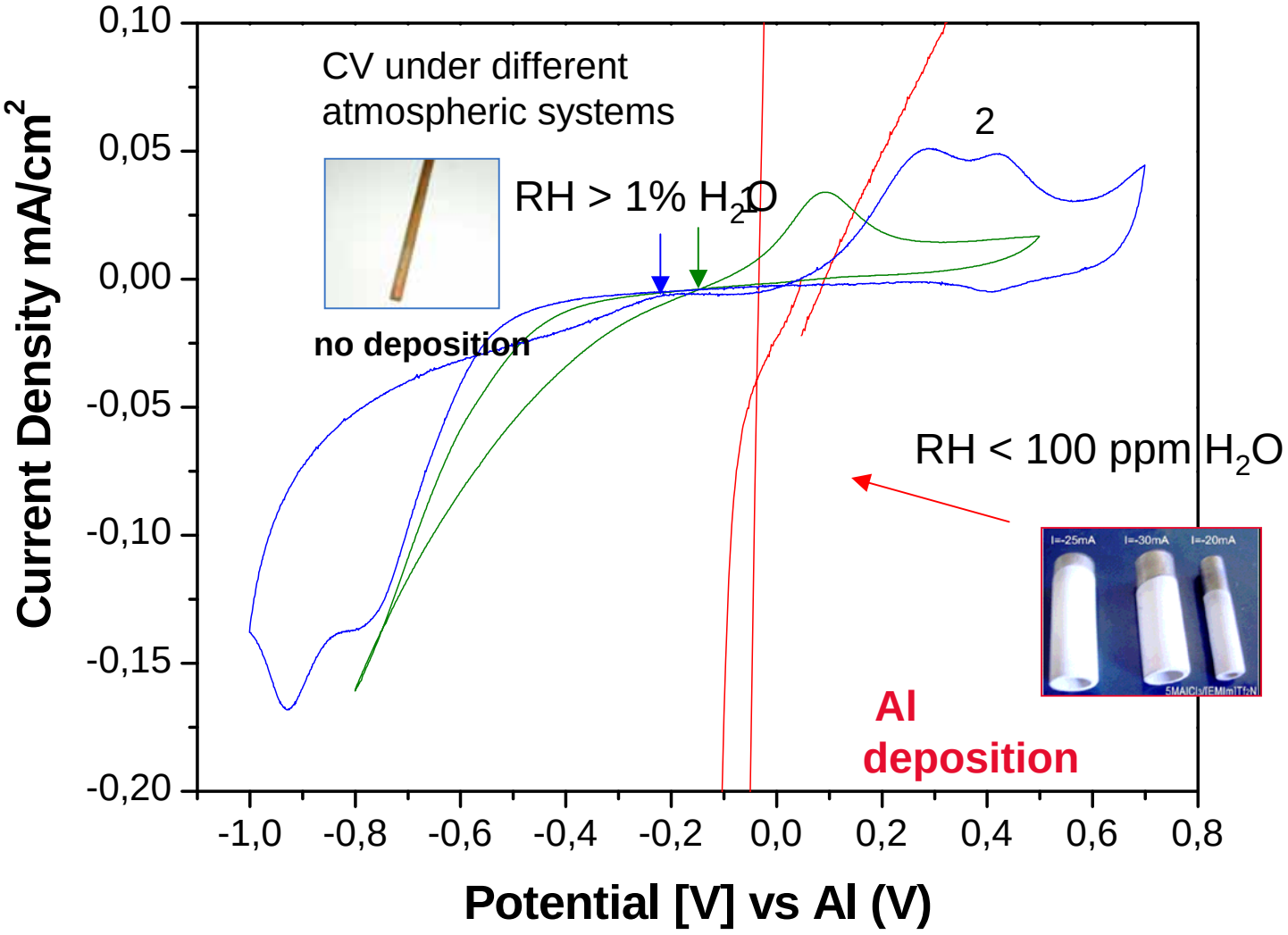
First Steps - Plating from Ionic Liquids: Aluminum



blue / **green**
„almost dry“

red
„absolutely dry“

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Plating from Ionic Liquids: Handling

Humidity sensitivity, closed reactors

Cost Calculation
At the moment we have to pay 15 to 150 Euro per liter for IL-solution.

For water we pay 10 cent per liter!

For comparison: a gold electrolyte costs roughly 90 Euro per liter..

We must think different!

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Pre-Treatment must be separated

Aqueous degreasing, rinsing

Aqueous pickling, rinsing

Aqueous activation, rinsing

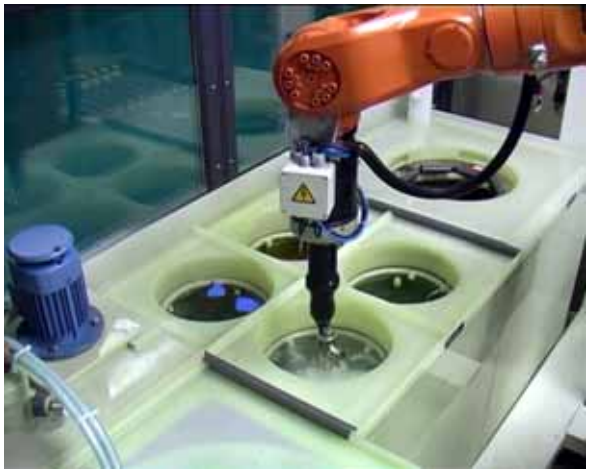
Pre-plate in an aqueous electrolyte possible

Drying, surface protection by alcohol or IL

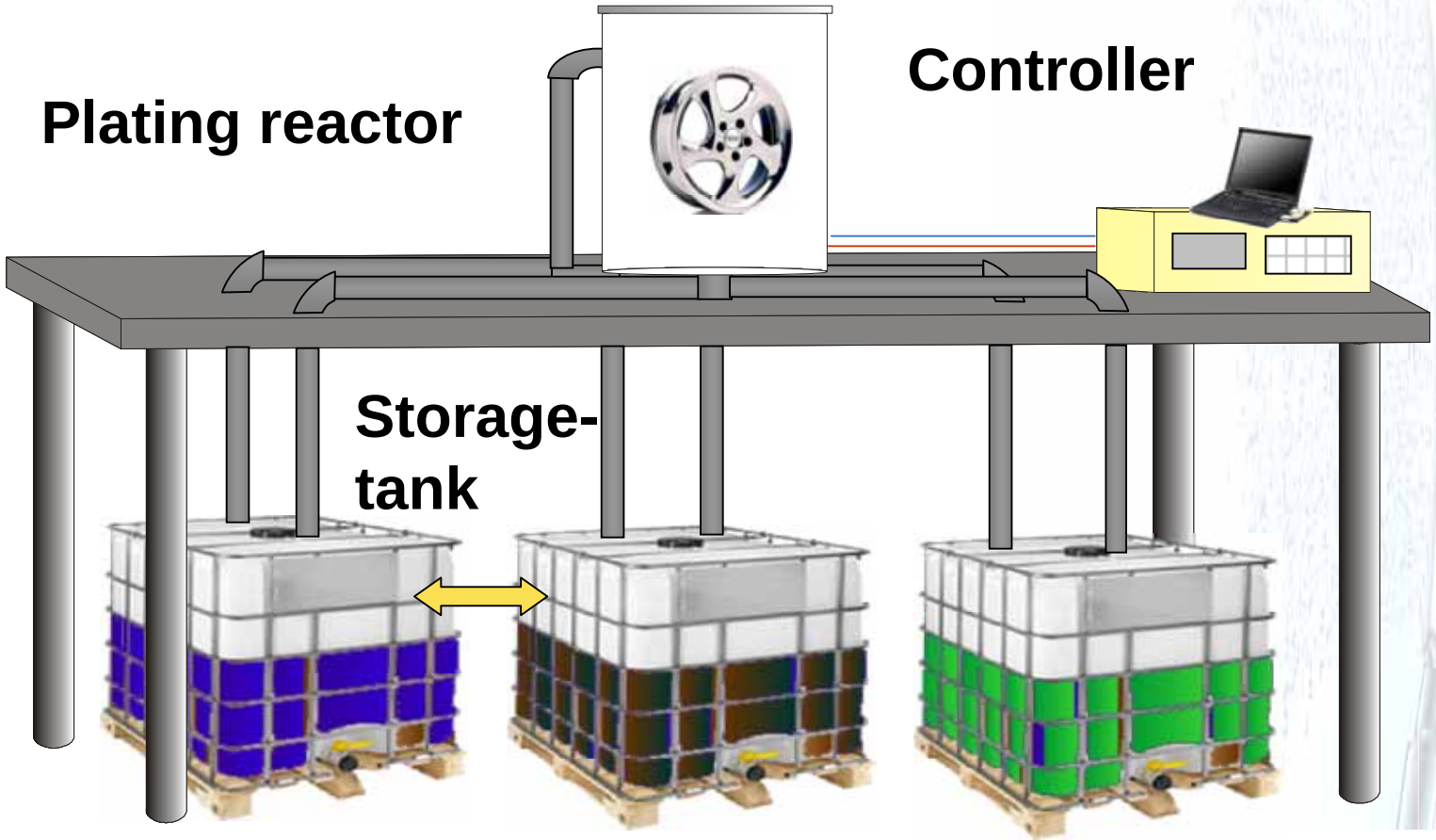
Transfer in the plating reactor

Plating from Ionic Liquids: Handling

- Contrarily to water based systems the precursor/solvent has the highest value in IL-system: Small selective plating reactors might be the way to go.

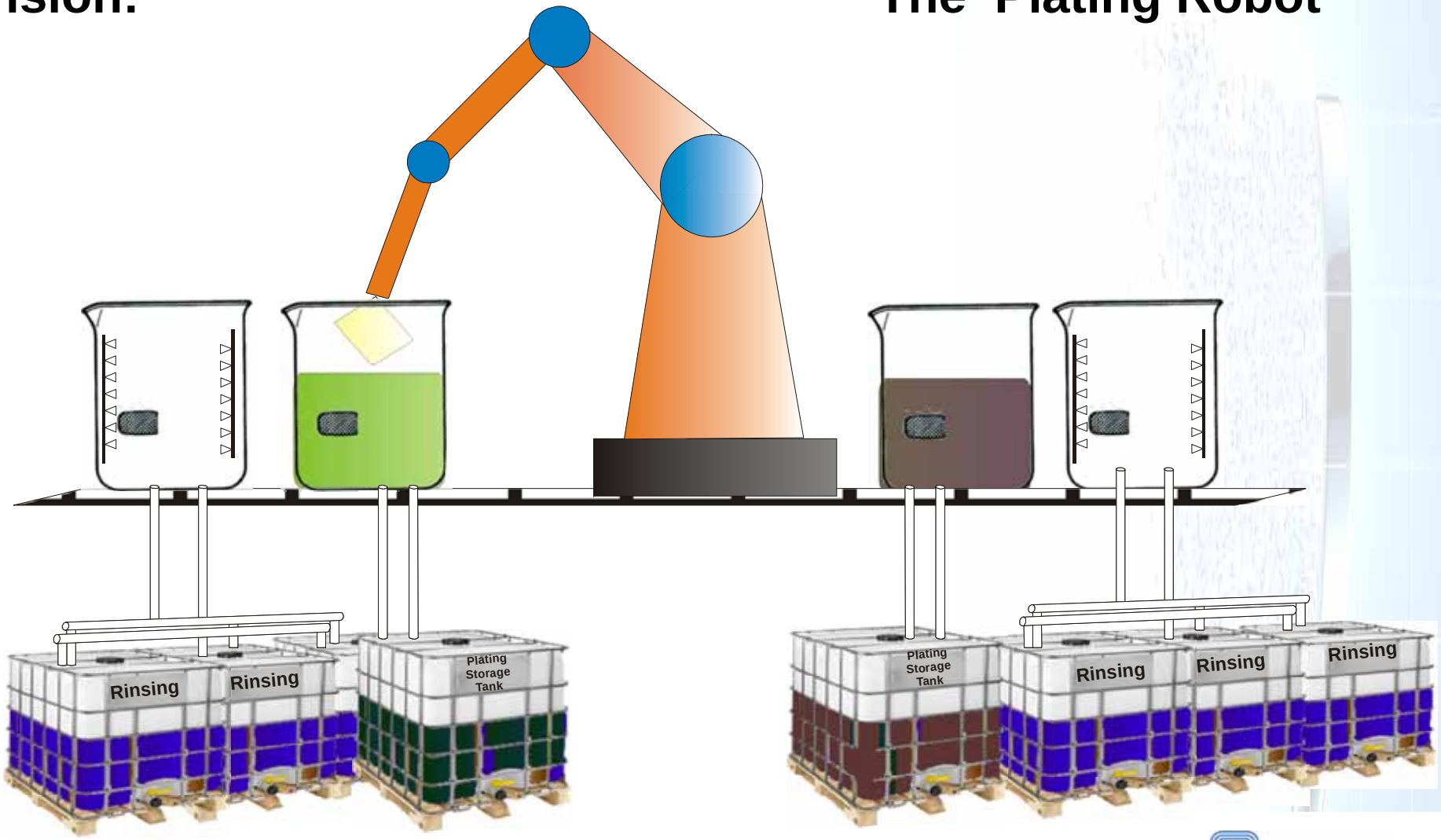


Single reactor-plating process



Vision:

The Plating Robot



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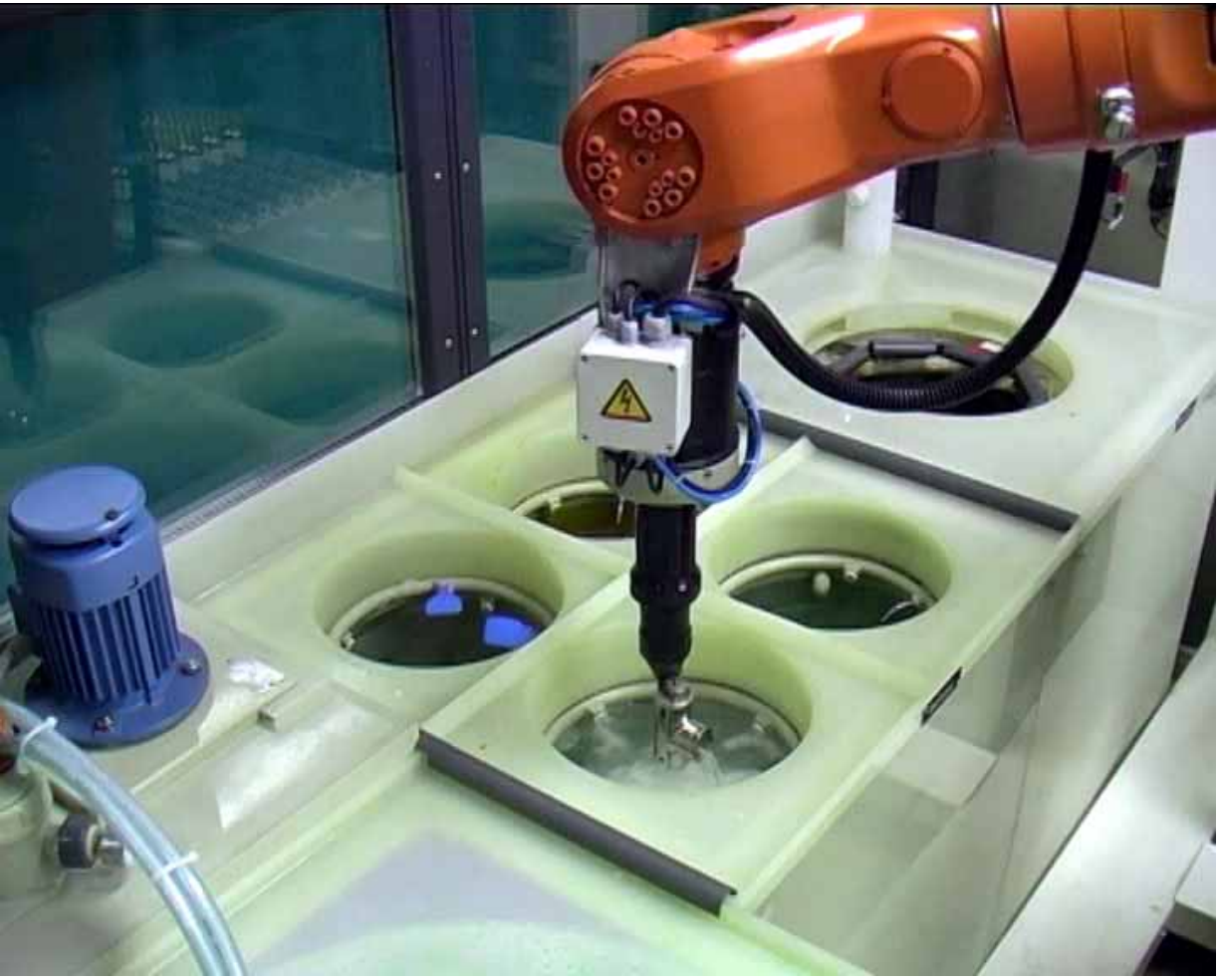
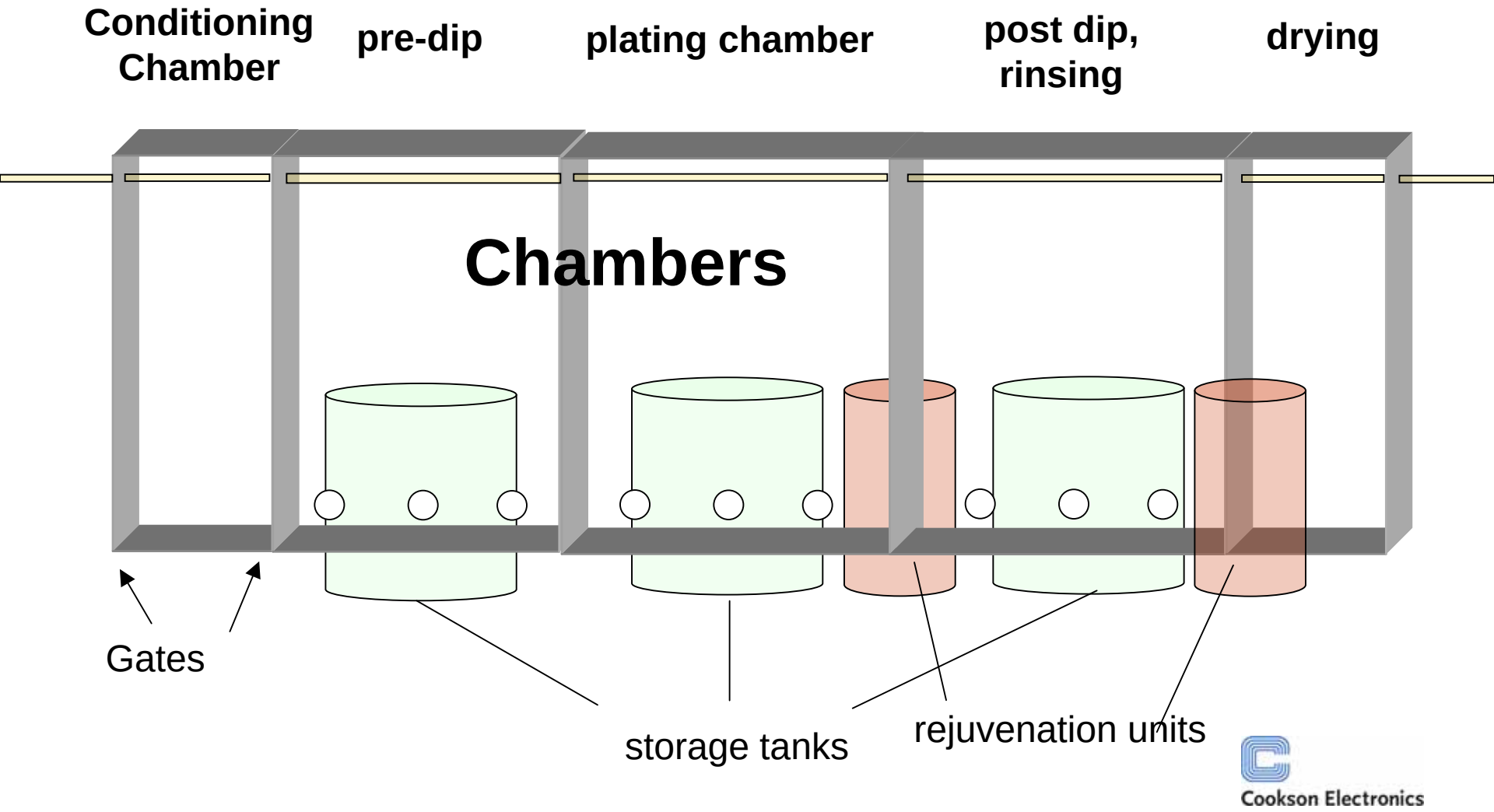
State of the Art at Dornbracht



With permission of Dornbracht

Plating roboter working at company Dornbracht

Upscaling: From Beaker to Plating Tank



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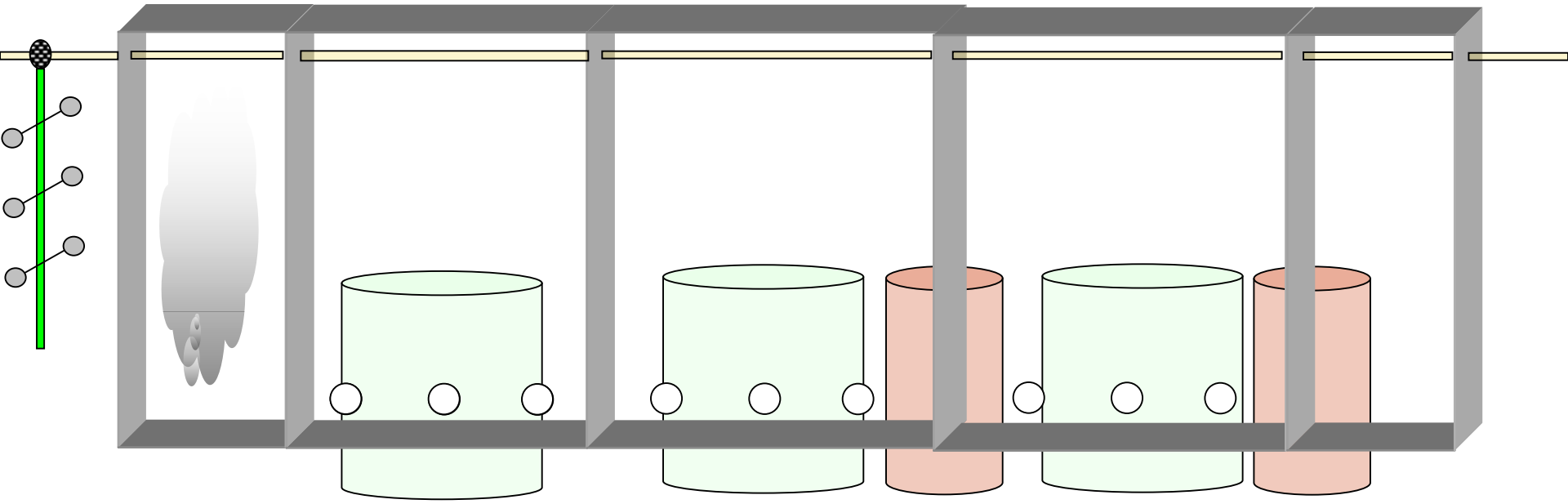
Upscaling: From Beaker to Plating Tank

„Conditioning“
with N_2



Multi chamber concept

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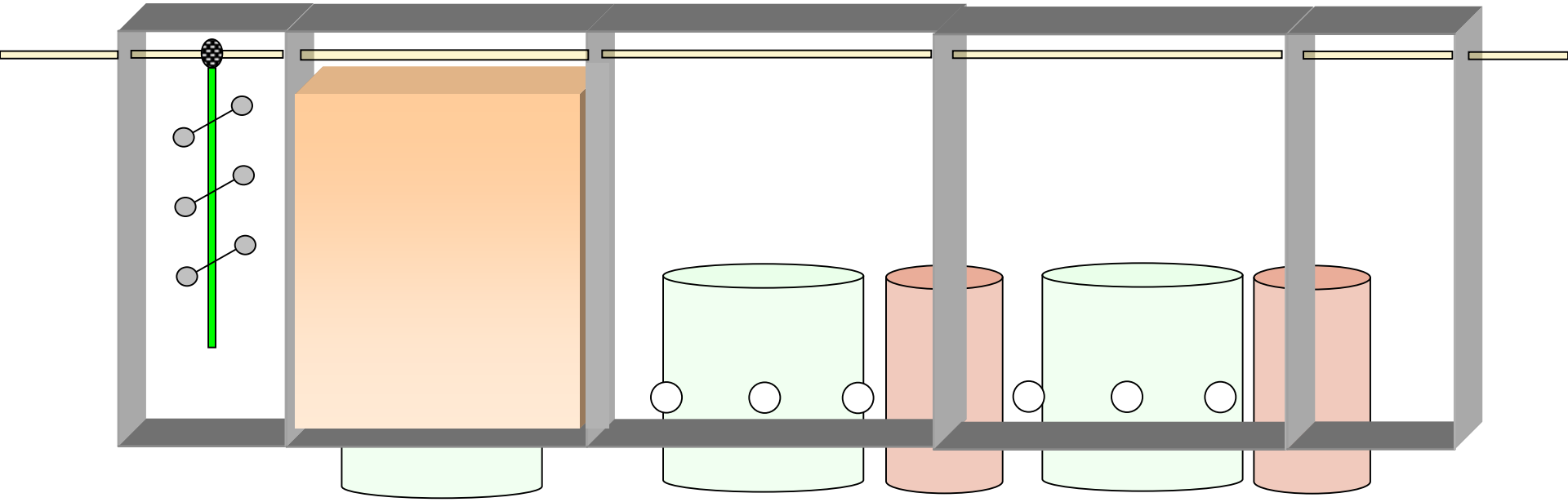
Technical concept:

Predip



Multi chamber concept

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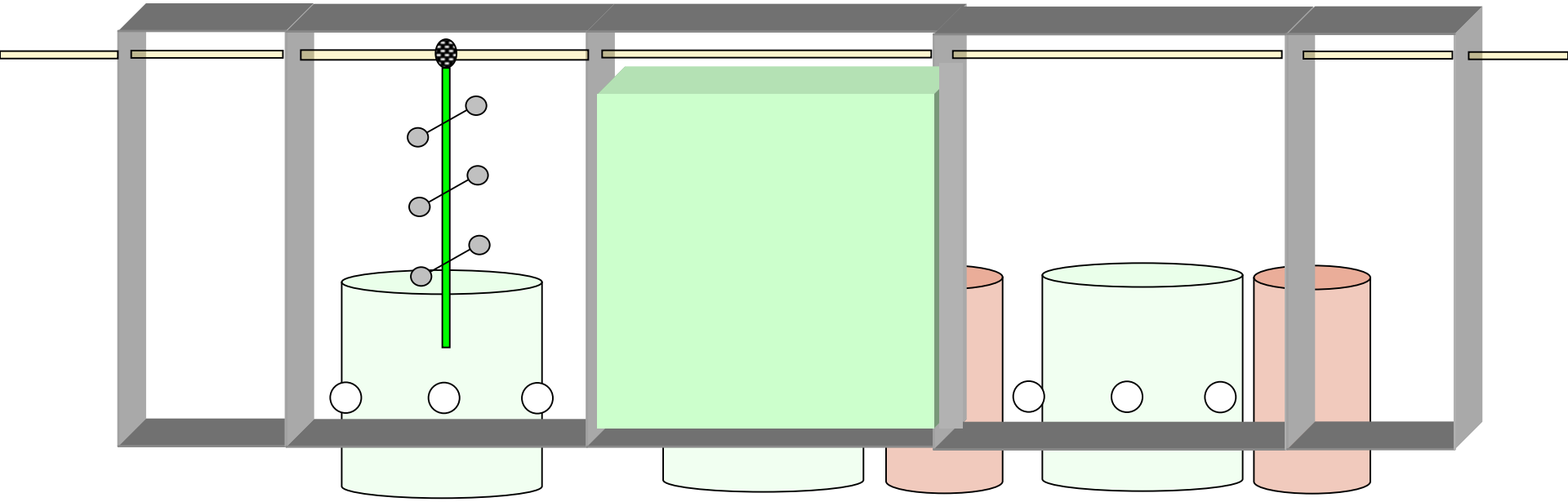
Technical concept

Plating Bath



Multi chamber concept

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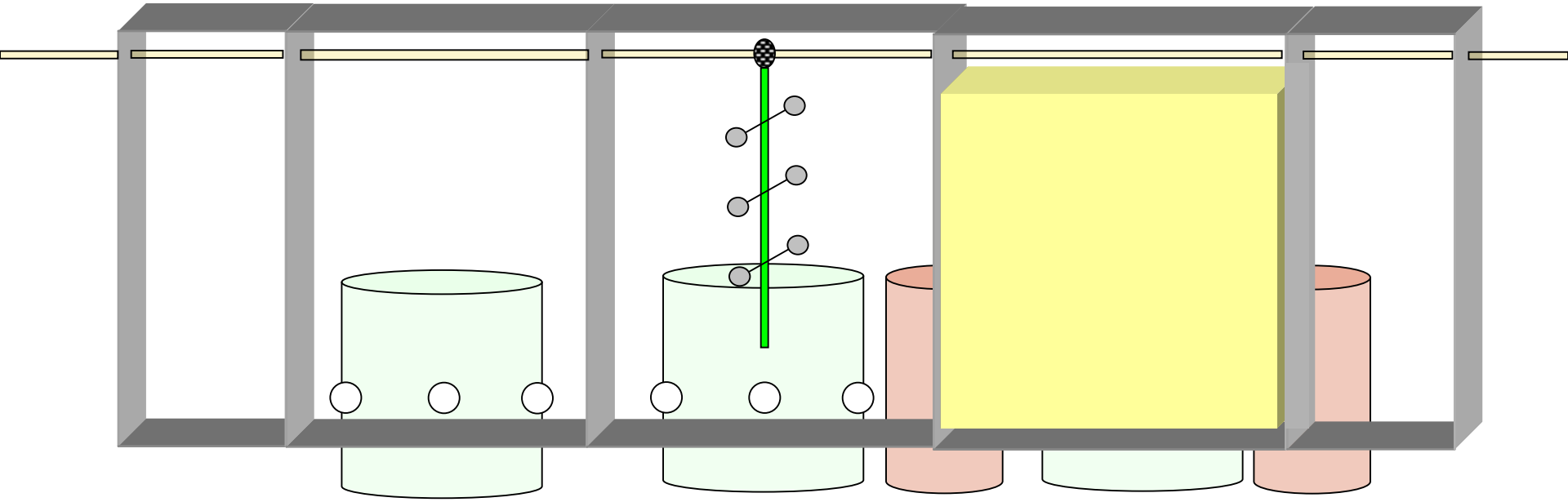
Technical concept

Post Dip,
Rinsing



Multi chamber concept

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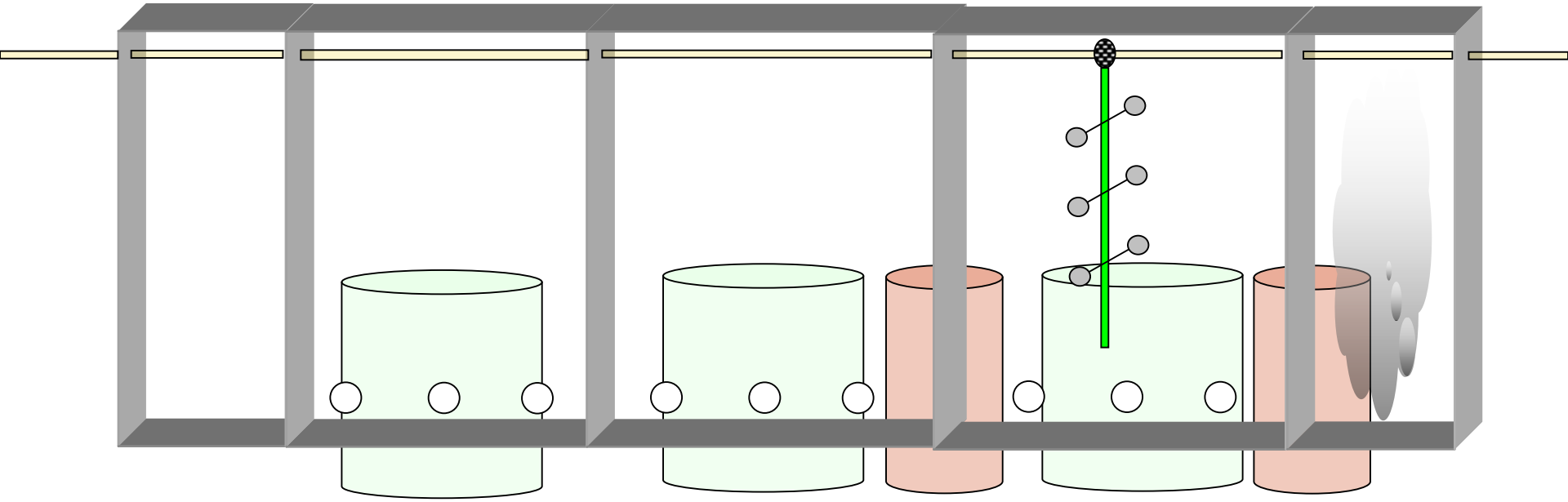
Technical concept

Drying



Multi chamber concept

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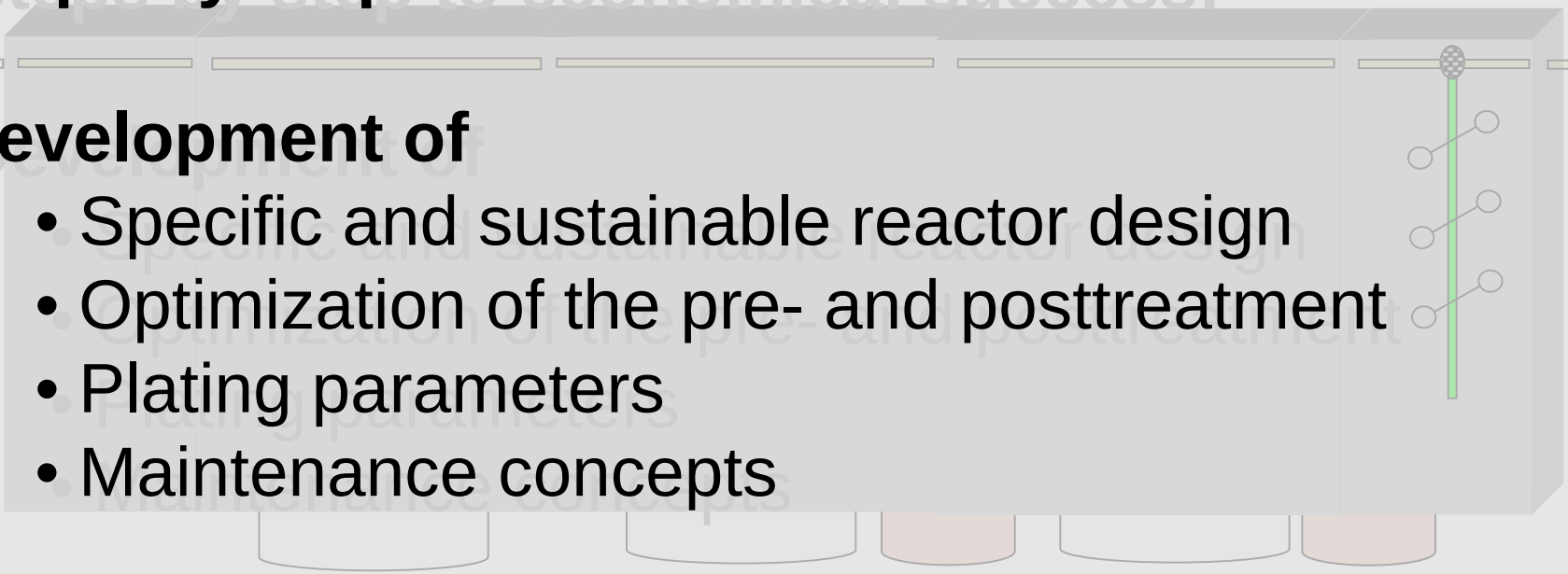
Technical concept

Steps by step to economical success:

Development of

- Specific and sustainable reactor design
- Optimization of the pre- and posttreatment
- Plating parameters
- Maintenance concepts



Single Reactor Concept

plating reactor

process chemistry

With permission of Gramm Technik

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Electrolyte Feeding to Single Reactors

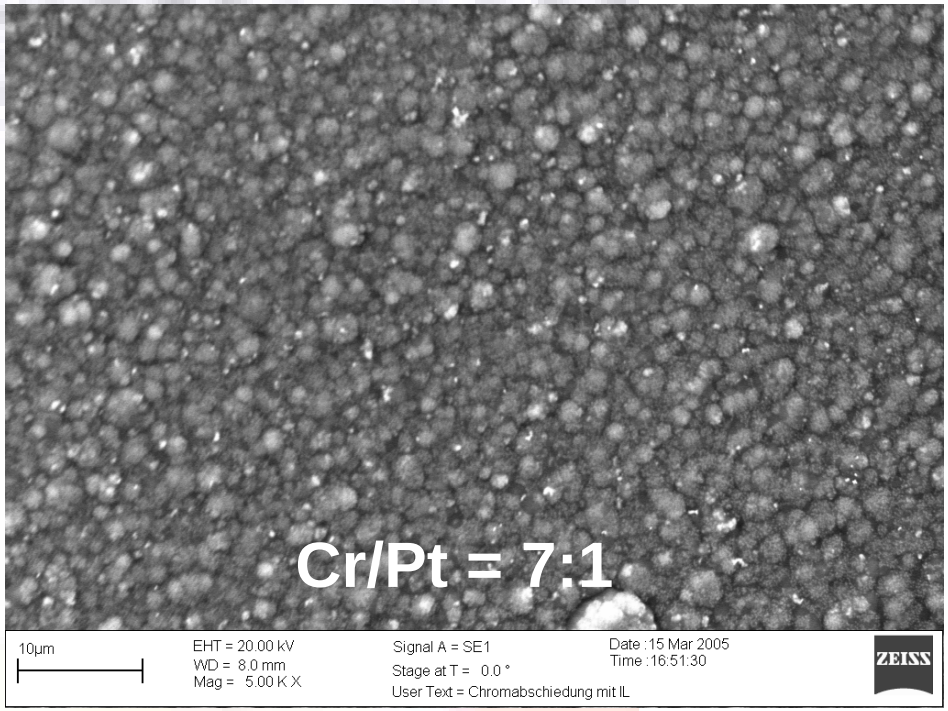
With permission of LPW-Blasberg Anlagen

Advantage of single reactor concept

- Pretreatment and rinsing in one reactor (optional)
- Small electrolyte volume (cost, regeneration)
- Electrolyte reservoir could be changed fast
- Low electrode distances possible
- High temperature (conductivity, viscosity)
- Closed reactor (humidity, gas evolution)
- Safety easy to control
- Automation possible

Evaluation of anodes, oxidation reactions…

Insoluble anodes are in different IL´s not longtime stable and the active layer will be slowly dissolved.
e.g. during Cr-deposition in a IL-electrolyte based on …..
Cr/Pt was plated in regard of the dissolution of Pt.



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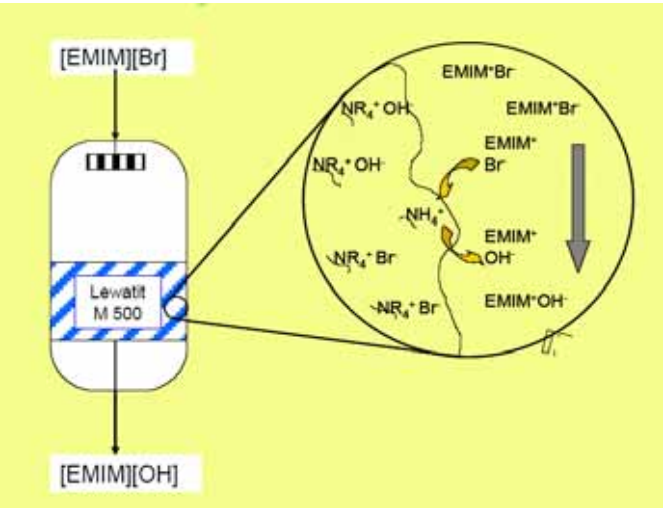
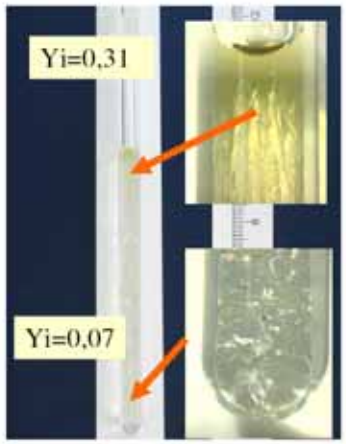
Metering of additives with ion exchange





Regeneration of Ionic Liquids by zone melting

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Plating from Ionic Liquids: Chromium

Plating Cr from Cr(III) / IL-system (e.g. Cholinechloride or BMImCl) leads to blackish & semibright Cr-layers. Layer thicknesses > 5 µm can be achieved.

Cr deposition on a door handle

Ionic Liquid containing Cr(III)sulfate

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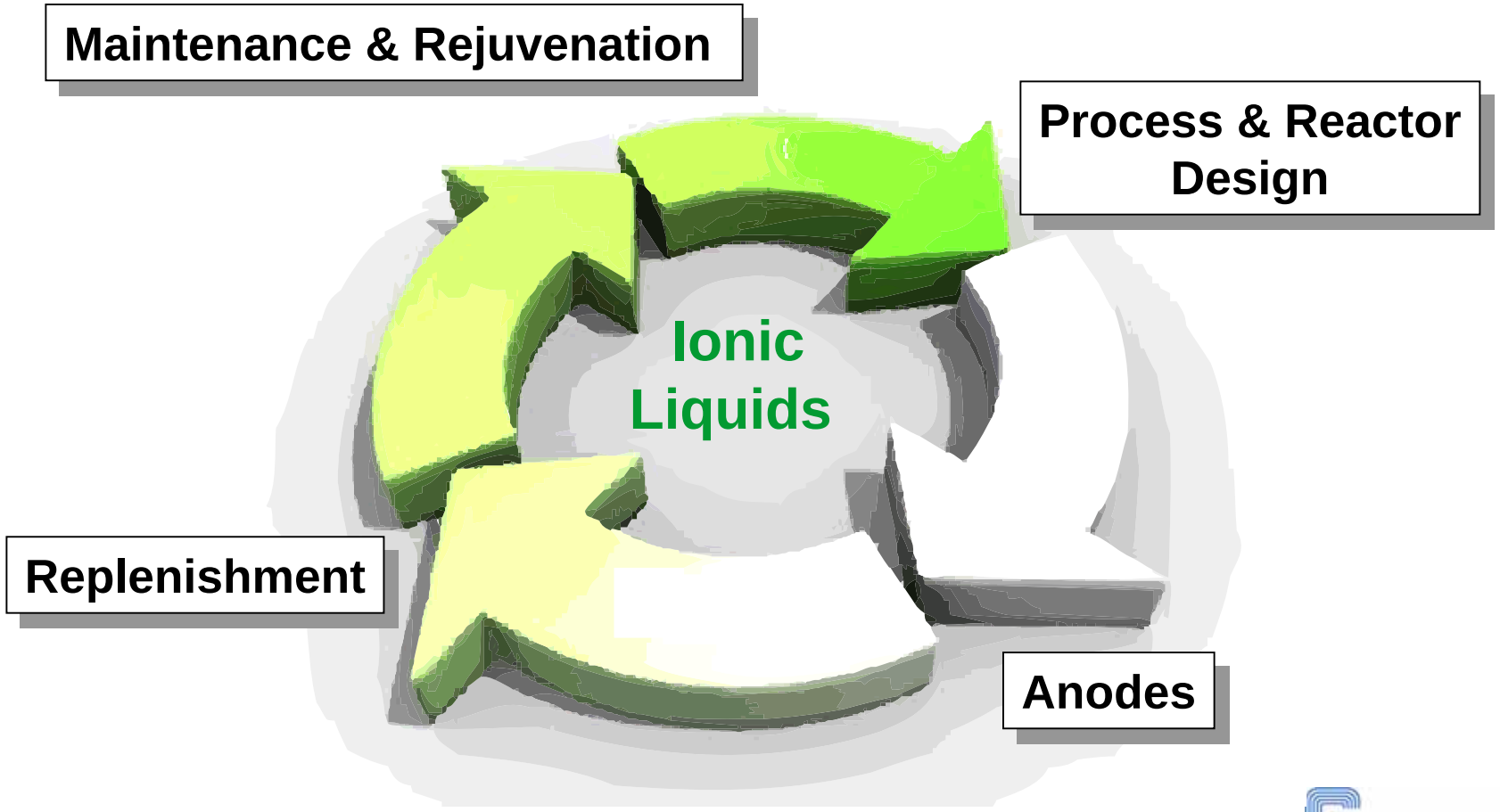
Plating from Ionic Liquids: It will be not only a good idea if we consider...



It is a real challenge to make these systems working....

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Acknowledgement

The work presented here was performed within support of the EU-project **IONMET**.
We thank all the participants for their support.

Thank you for your attention....

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