



Influence of Electrolysis Parameter on the Co-Deposition of Impurities during Silver Electrorefining

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Poster Description

Due to the high standards for silver in electronic uses, it is essential to control the impurity behaviour during the electrolytic refining. Furthermore in regard to more precious metals than silver, it is indispensable to control their complete transition to the anode slime. But from an economic point of view, it nevertheless becomes more and more relevant to use less pure electrolyte systems and insert more contaminated anodes into the refining process due to the otherwise high necessary silver stock. Additionally, economic reasons cause an increase in current densities and accordingly an increase in production capacities and a decrease in refining duration. Therefore, the impurity behaviour needs to be controlled and influenced during the electrolytic refining process.

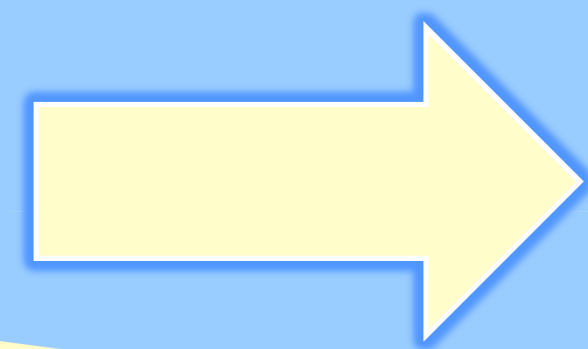
Basic electrolysis parameter through which the process can be influenced and controlled are the current density, hence the applied potential on the electrode, and the acid concentration in the electrolyte. The applied electrode potential shows great influence on the dissolution behaviour of more noble metals than silver at the anode and on the co-deposition of less noble metals, such as copper, at the cathode. This phenomenon is based on the Nernst equation. The pH of the electrolyte system and thus the acid concentration influences the solubility behaviour of the impurities and therefore their concentration in the electrolyte and co-deposition on the cathode.

Experimental results show, that in a range of anodic current densities from 500 – 800 A/m² and a nitric acid concentration from 1 – 10 g/l the pH of the electrolyte system show a great influence on the behaviour of palladium and a slightly smaller influence on the co-deposition of copper. Consequently, it is indispensable to control the pH for an electrolyte refinery if the production rate and thus the current density shall be increased.

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Motivation

- High standards for electro refined silver make it indispensable to control the impurity behaviour during the electrorefining process.
- In case of PGM's such as palladium, it is even more important to control their complete transition into the anode slime. Otherwise the yield and thus the economic recovery of PGM's would suffer.
- Due to decreasing electrolyte purities and increasing anode contamination, higher current densities become unattractive caused by co-deposition of less noble elements, especially copper.

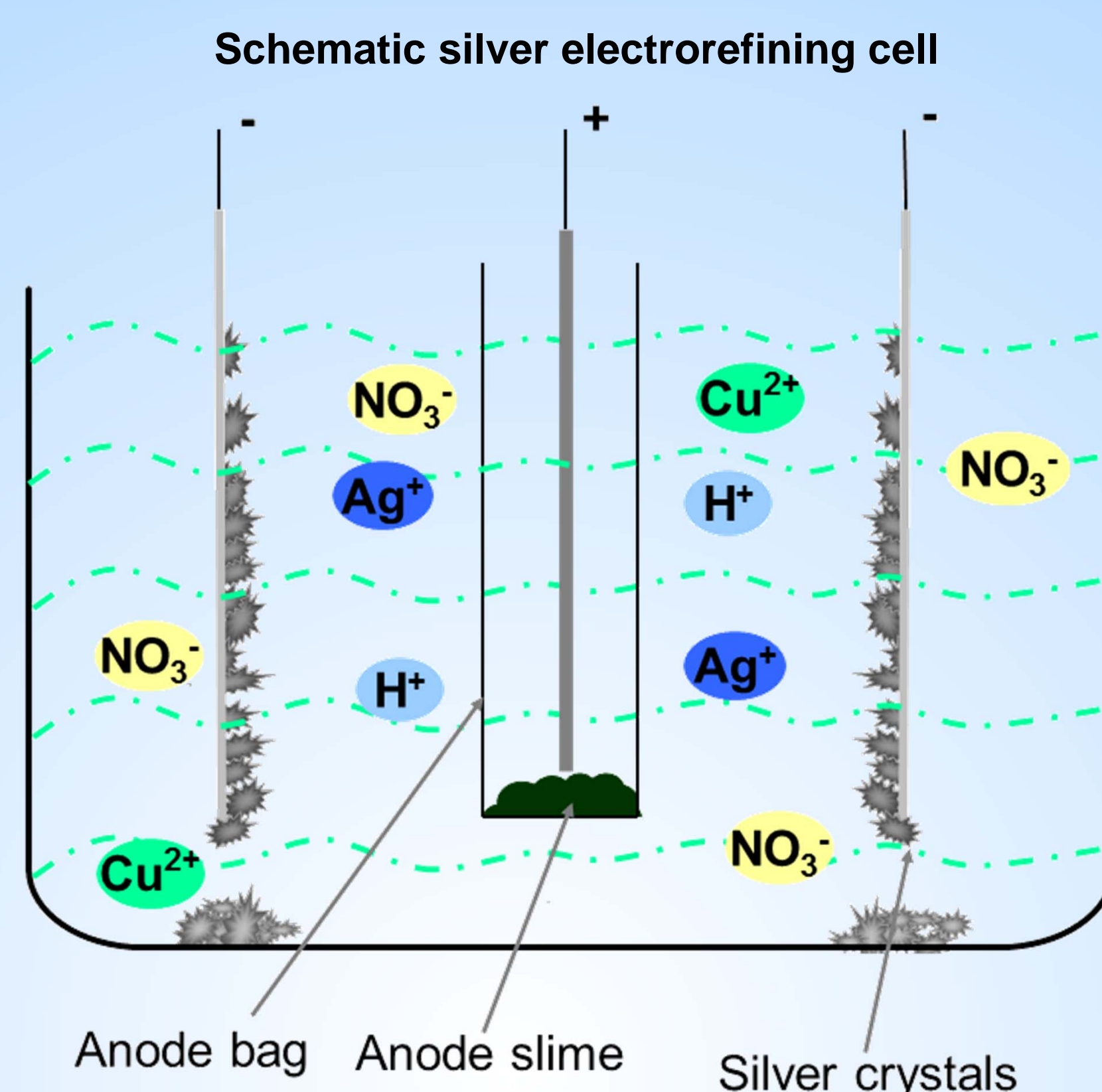


Overall objective is a higher production capacity, which results in a lower silver stock due to higher production rates

Influencing factors and experimental methodology

Influencing factors

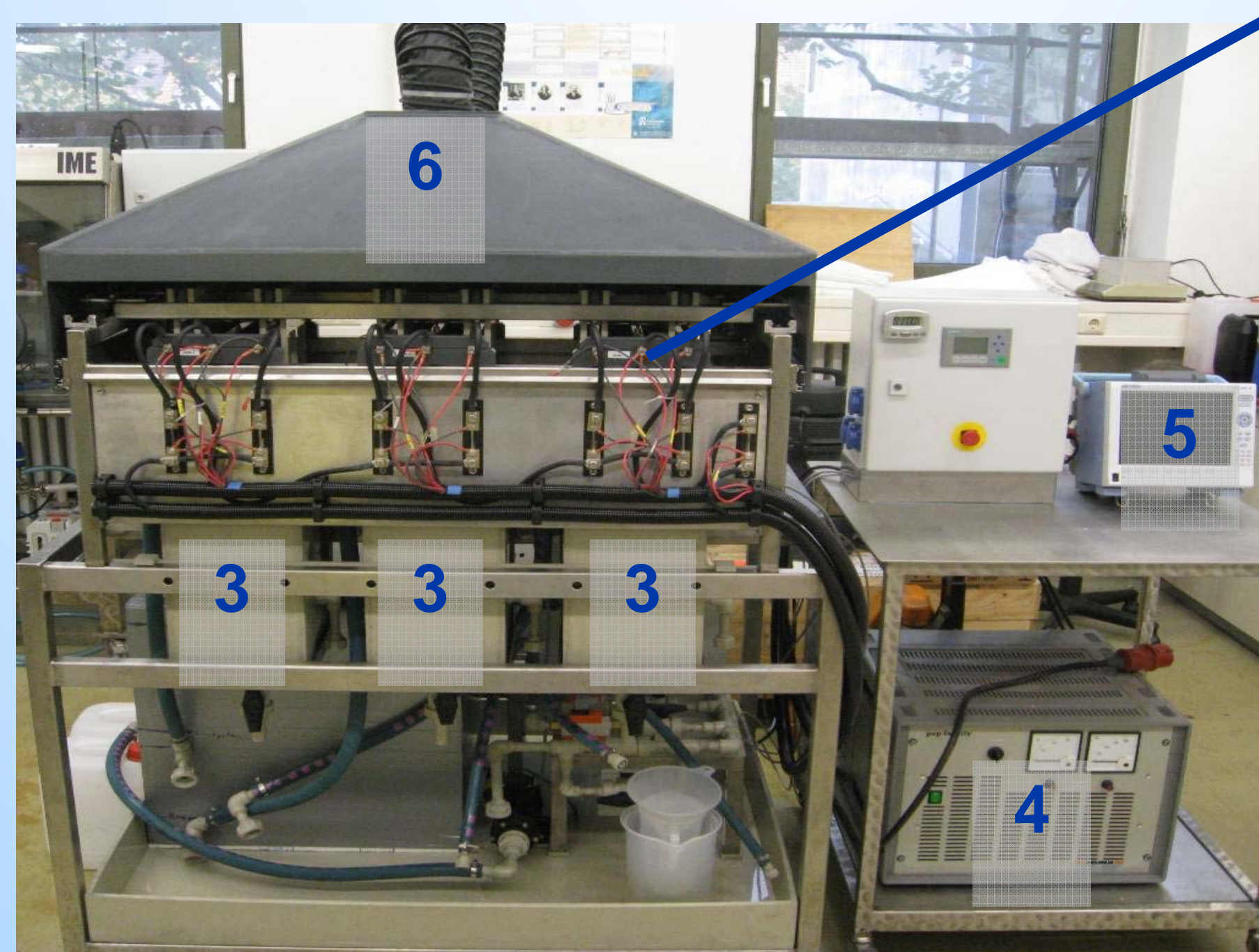
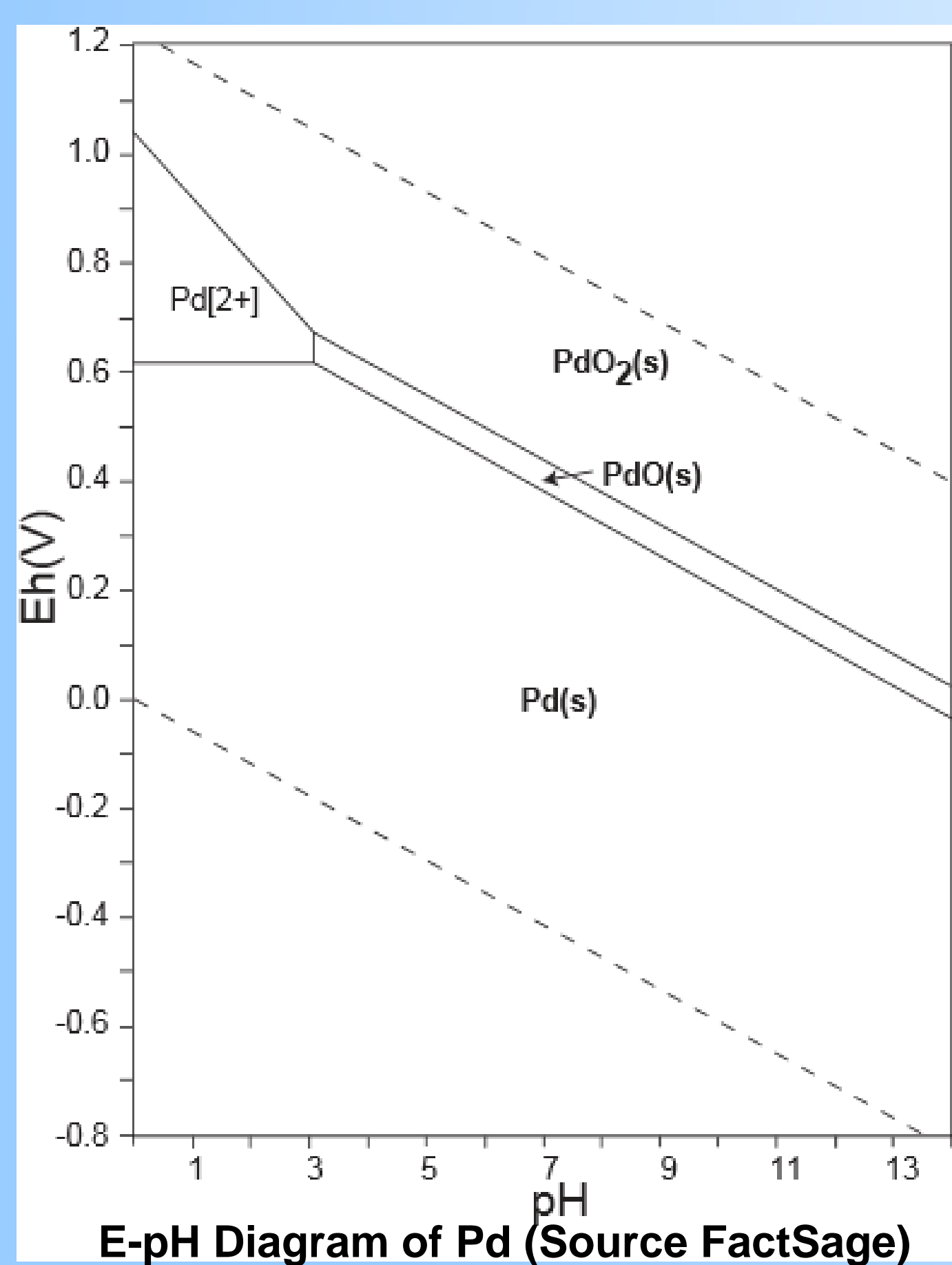
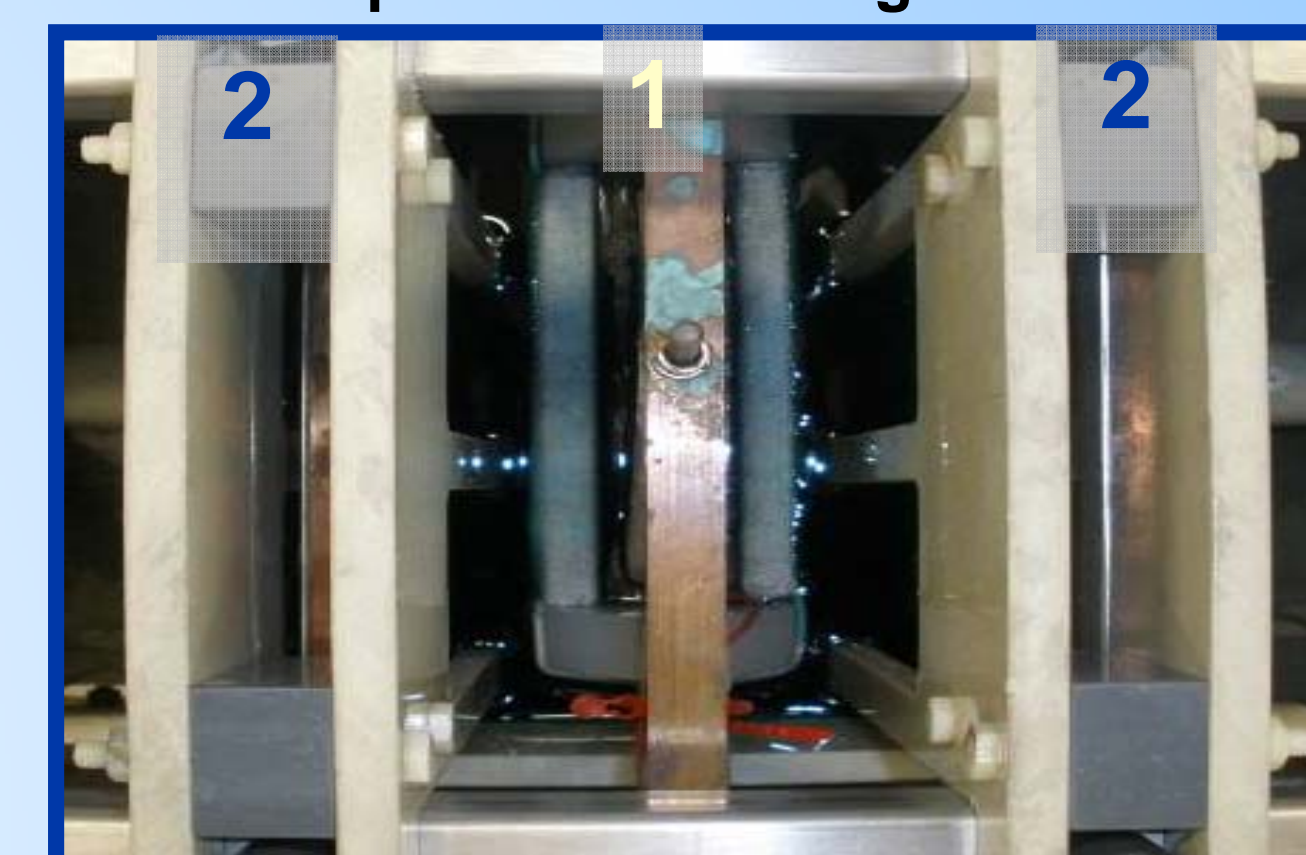
- Current density directly influences the electrode potential → anodic dissolution and cathodic precipitation of impurities directly correlates to current density (through Nernst equation)
- Acid concentration influences solubility behaviour of impurities such as Pd (see figure below)
- Amount and type of impurity in anode and electrolyte has great influence on impurity behaviour



Experimental equipment

1. cathodes/1 anode per cell
2. Scraper system
3. 3 cells à 23 l out of polypropylene
4. Anode bags (woven polypropylene)
5. Rectifier with max. power of 6 kVA
6. Digital data acquisition (U, I, electrolyte volume flow)
7. Fume hood

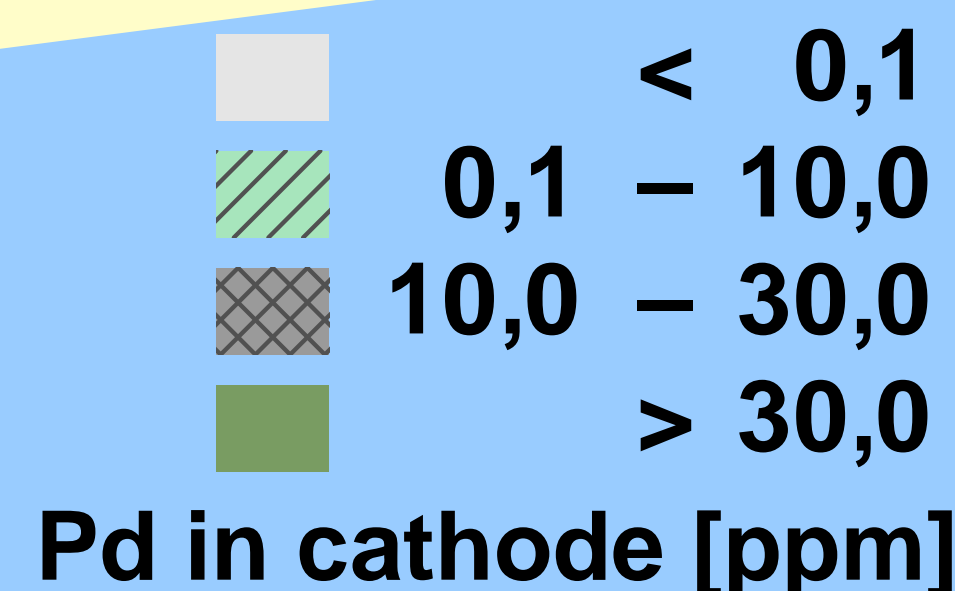
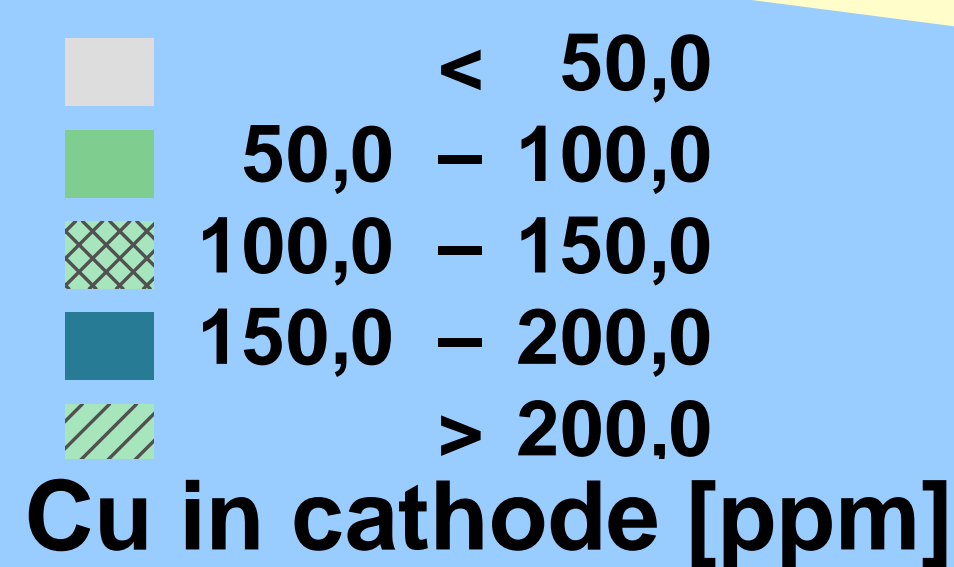
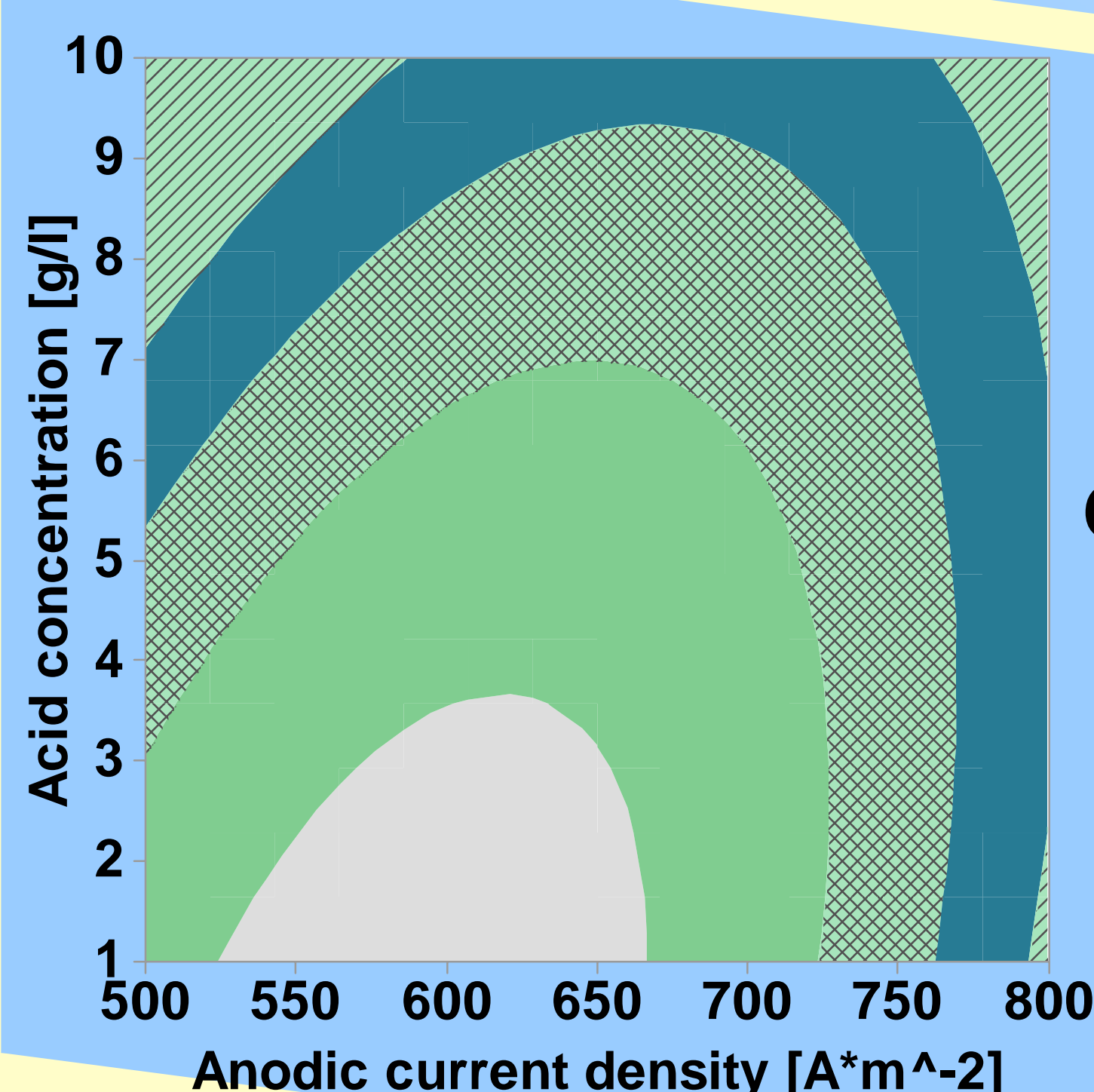
Top view on running cell



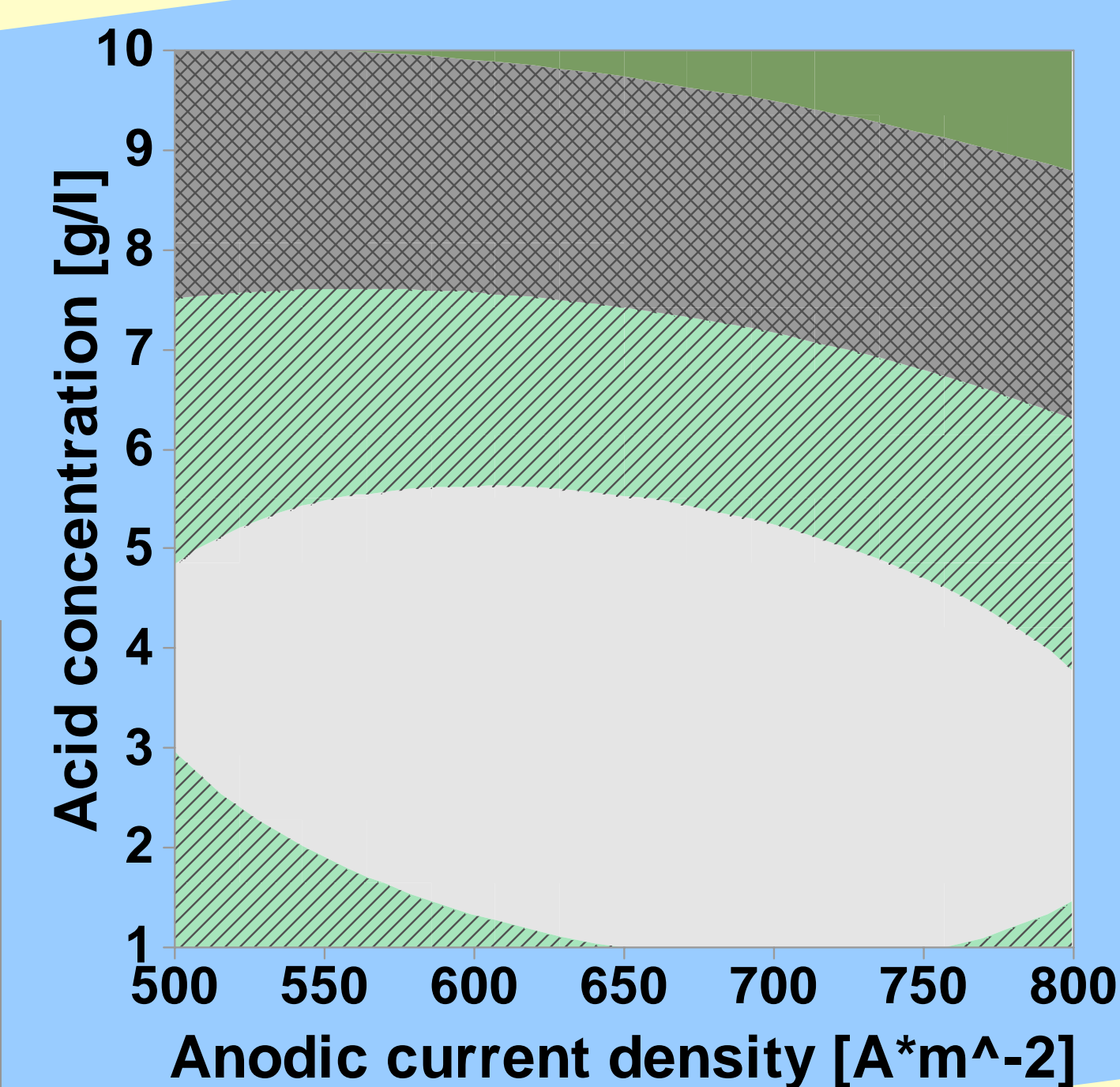
Methodology

- different parameter variation in 12 experiments:
 $i_a = 500 - 800 \text{ A/m}^2$ and $C_{\text{HNO}_3} = 1 - 10 \text{ g/l}$
 - Equal conditions in 3 parallel cells (see figure on the left) during one experiment
- Overall goal is to define optimized operational areas via experimental variation of different electrolysis parameter

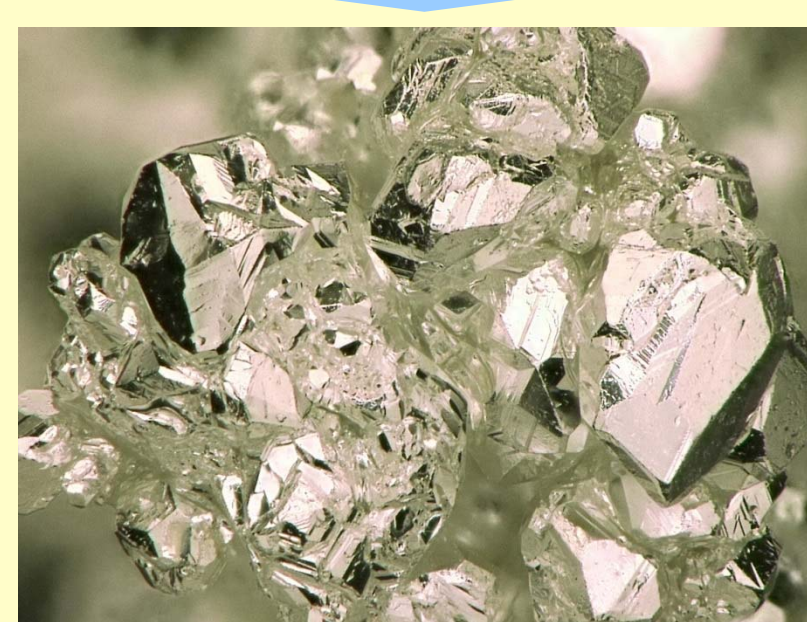
Results



- Acid concentration shows greater influence especially on Pd (and partly on Cu) behaviour than current density
- Optimized operational area:
 $i_a = 600 \text{ A/m}^2$ and $3 - 5 \text{ g/l HNO}_3$
- pH control of electrolyte essential during electrolytic refining in order to produce fine silver



High grade silver



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