

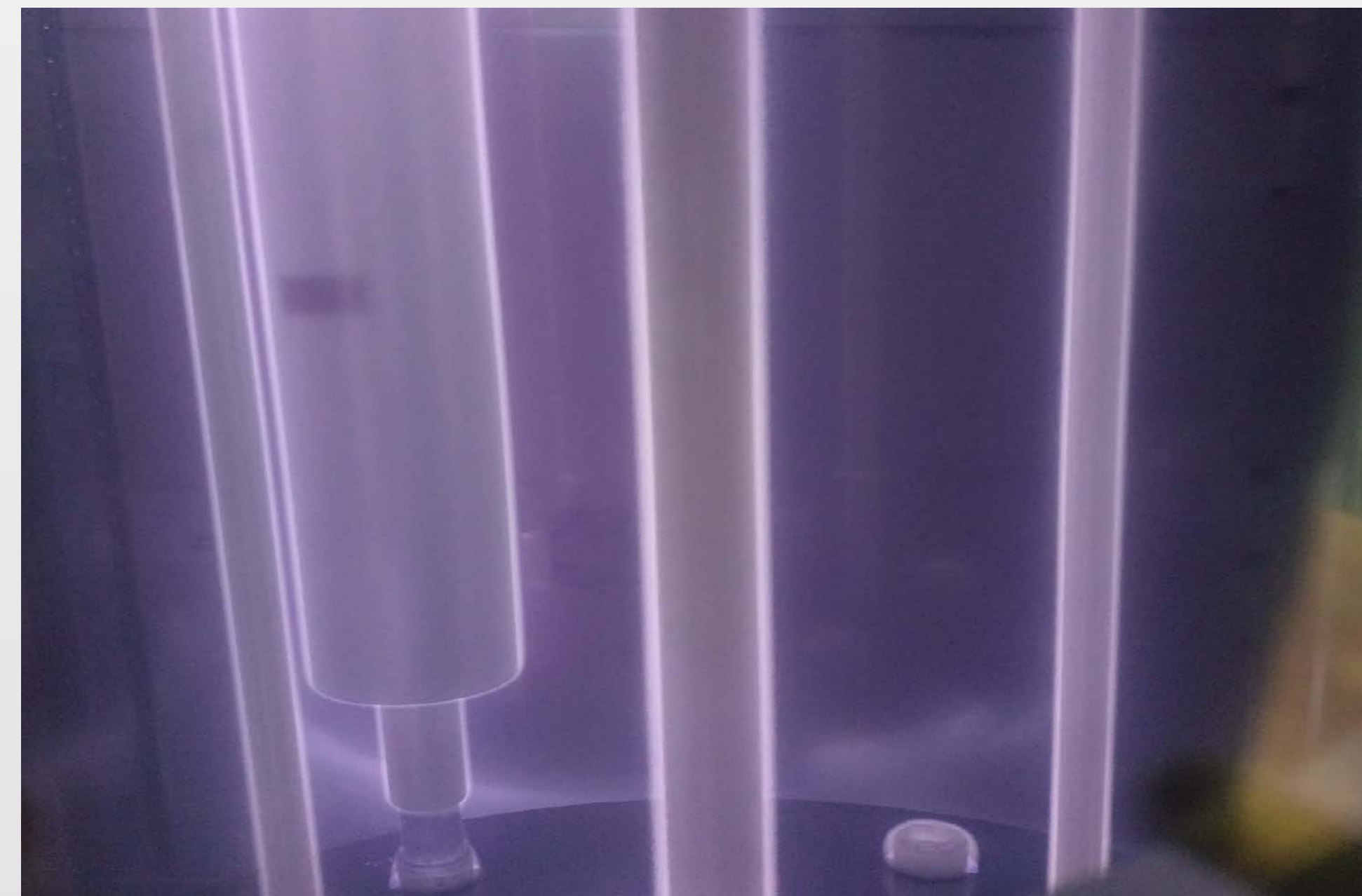
Hybrid Chrome Replacement "HCR"

Introduction

- Chrome trioxide (CrO₃) is an essential precursor for any wet chemical chrome plating process.
- In its oxidation state VI it is a very toxic and highly corrosive compound and a known carcinogen.
- CrO₃ was listed in 2013 as a dangerous and environmentally harmful substance by EU-REACH legislation. Its continued use for chrome plating is, therefore, likely to be banned completely in the near future.
- PlascoTec has successfully developed an alternative green technology with superior performance to replace wet chemical chrome plating widely used to date.



Image source: <https://www.hdt.de/galvanik-von-a-z-der-weg-durch-das-rechtskataster-seminar-h090121568>



Plasma-based deposition Technology

- Replacement of chrome precursors and all related wet chemical process steps by carbon-based thin films (DLC).
- First industrial trials for galvanic chrome replacement started in 2011 have shown the general feasibility as a superior chrome replacement.
- In 2016 an international multi-million EU-R&D project for further development and industrialization was granted.
- With the approach proposed all wet chemical process steps could be successfully eliminated in an industrial scale.
- Large area coating systems have been constructed and installed on PlascoTec's premises and are now available for industrial use.

COMPARISON	HCR	CR
Hardness [HV]	3.500	1.100
Friction coefficient:	<0.1	2.0
Thickness:	1.5-2 um DLC (precoat 3um)	8-10um
Raw Material:	none-toxic	Carcinogenic
Cleaning:	+++	0
Deposition:	Plasma	Galvanic

Properties of HCR

- Hardness of the carbon-based coatings is approx. 3 times as high as chrome.
- Compared to chrome the coefficient of friction is drastically reduced.
- Due to this, abrasive wear is extremely low.
- Additionally, surface properties such as wettability can be tailored to suit different applications.

Green Technology

Advantages of HCR

- Superior coating properties compared to chrome.
- Carbon-based coatings are derived from non-toxic gaseous precursors.
- Drastically reduced gaseous precursor consumption.
- No hazardous working conditions
- Also, no environmentally harmful substances and byproducts are used and/or produced during the HCR-process.

Outlook

- Plasma-based processes are often considered to be expensive and time consuming
- Therefore, PlascoTec's main targets are:
 - cost reduction by extensive parallel processing
 - rate increases by innovative plasma excitation schemes
- Current status:
 - Industrial pilot test-applications are underway worldwide
 - First installation and operation of commercially available systems in 2020.

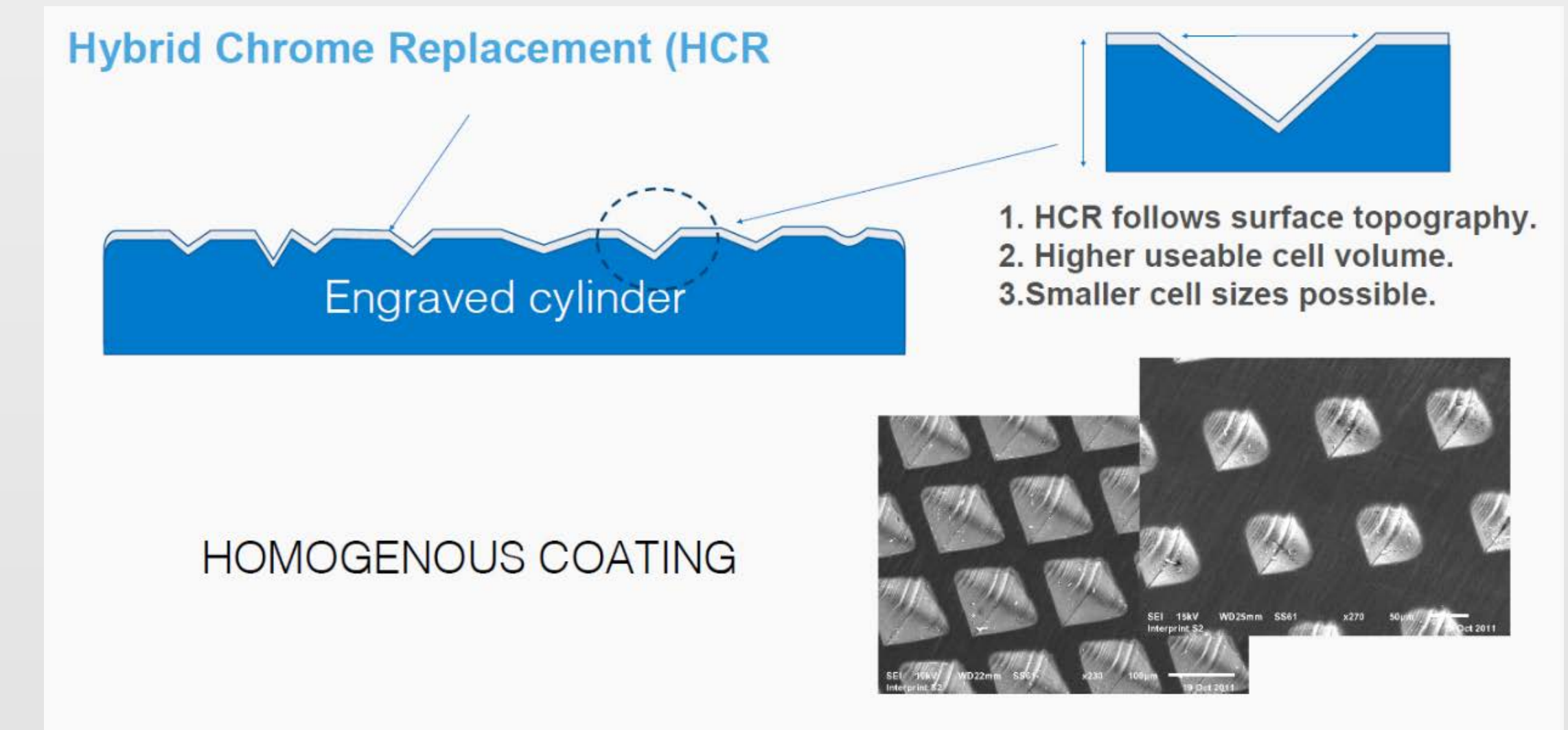
Example : Roto Gravure Printing

- Rotogravure printing is a multi-billion market worldwide
- Traditionally, printing cylinders are chrome-plated to increase wear resistance.
- Chrome for gravure cylinders can only be used for a limited time by exception due to the EU-REACH legislation.
- The industry is urgently looking for a future proof "green technology" to replace chrome.



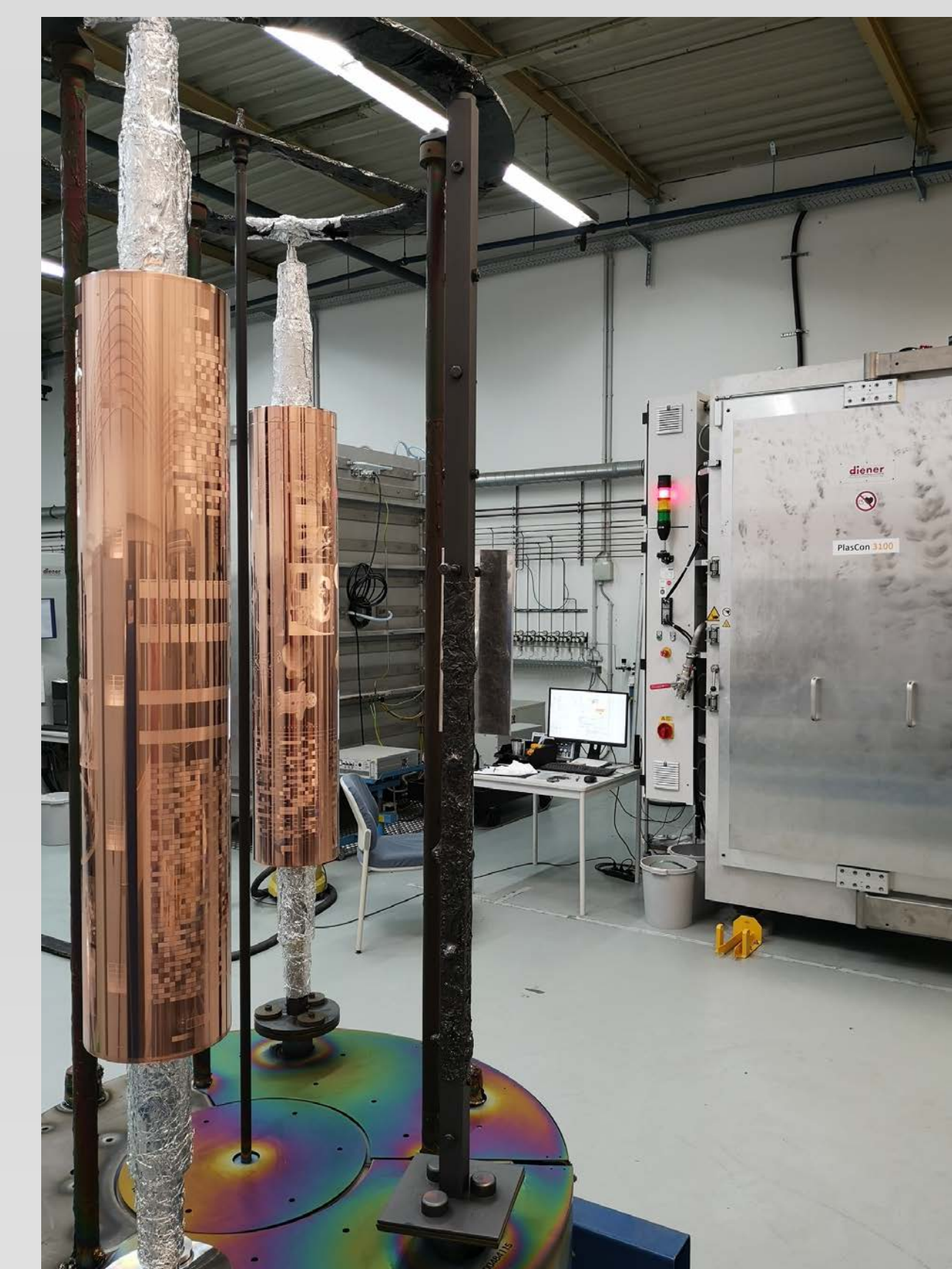
Image source: <https://www.print.de/thema/tiefdruck/>

Replacement of chrome on printing cylinders



Main Advantages

- Technically superior to traditional chrome plating
- Life time of cylinder is extended by up to 5 times
- No toxic substances for cylinder plating needed
- Improved ink release from cylinder surface
- Reduced ink consumption (5-10%)
- Easy-to-clean (water based inks)



Exploitation and commercialization

- 6 Cylinders of up to 2 meter overall length can be coated simultaneously in the current PlascoTec coating system
- Competitive pricing compared to chrome plating
- Fully automated cylinder coating machines are under development
- Introduction of job coating services in Europe, North America and China in 2019/2020

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