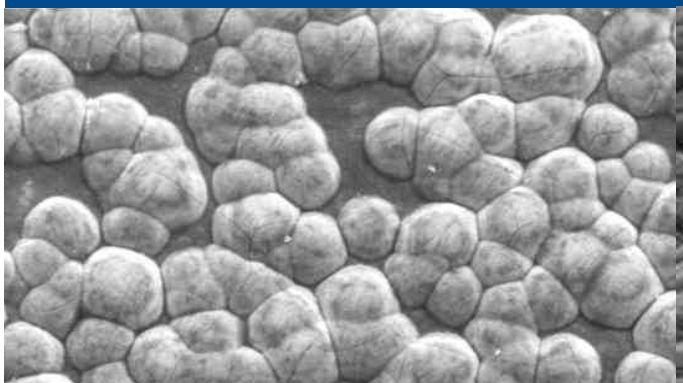
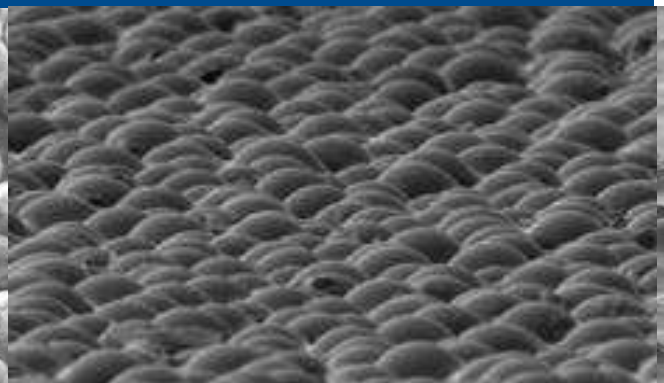
Innovation for Industry „NanoEngineering“ April 2010

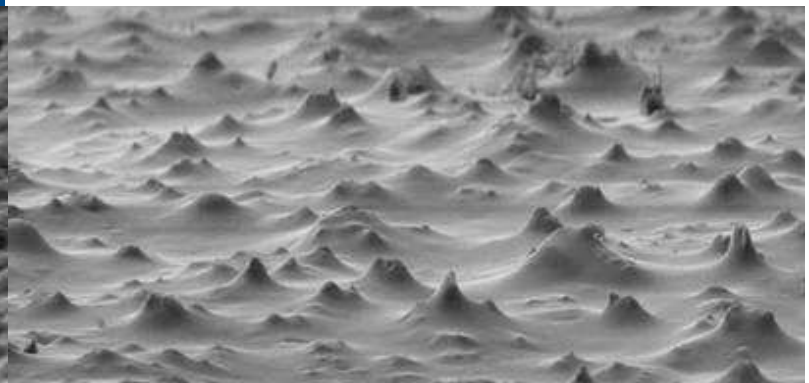
New Materials and Principles for Transport Surfaces in Printing Machines

Dr. W. Kolbe, Technology Projects, Heidelberger Druckmaschinen AG

HEIDELBERG







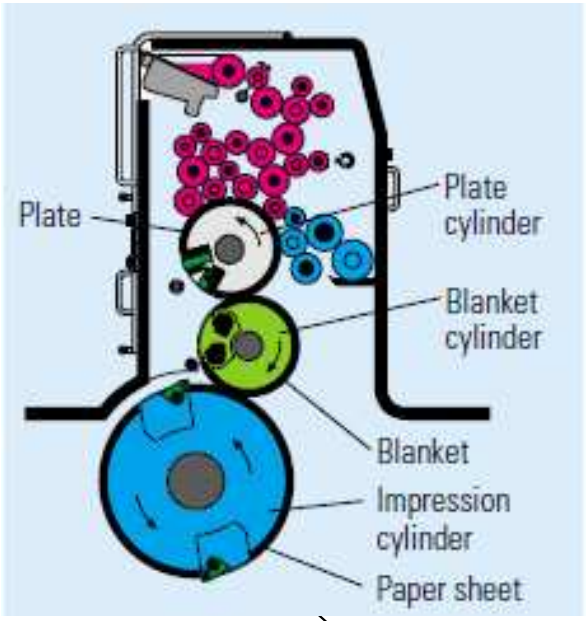
Agenda

1. Introduction
2. Goals
3. Results
4. Summary
5. Future Challenges

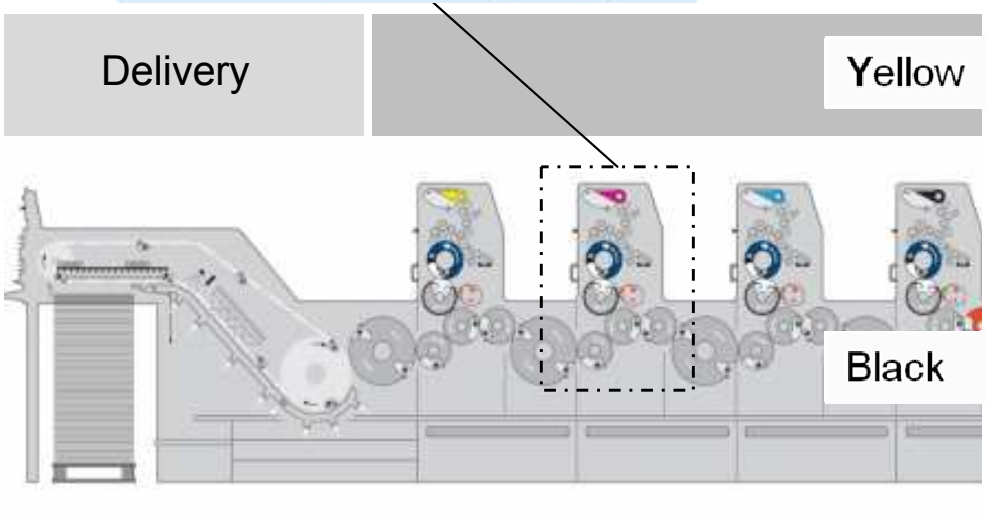
Heidelberg is market and technology leader in sheetfed offset

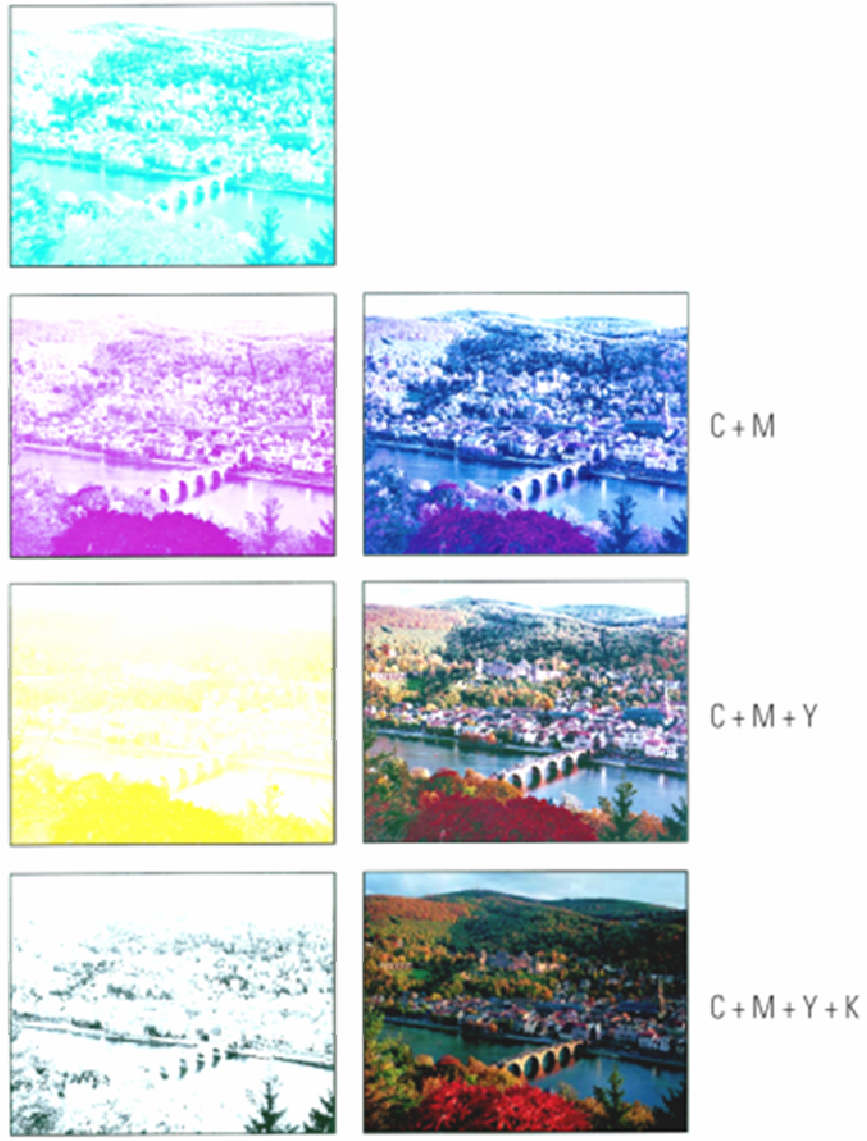
- World-wide technologically leading supplier of sheetfed offset solutions
- Sole supplier of seamlessly networked solutions from prepress to postpress
- Customer and market closeness as well as a strong service orientation result in clear differentiation from competition
- Approx. 200,000 customers in 170 countries

Scheme of an Offset Printing Machine



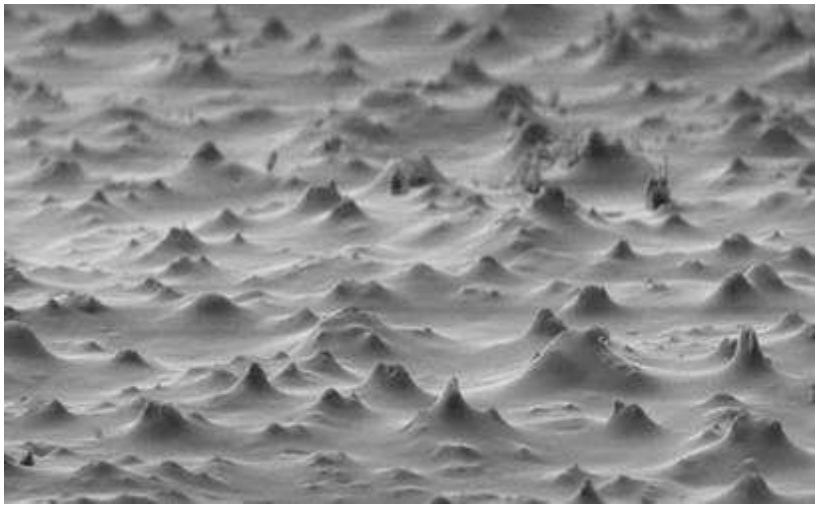
Source: Handbook of Print Media

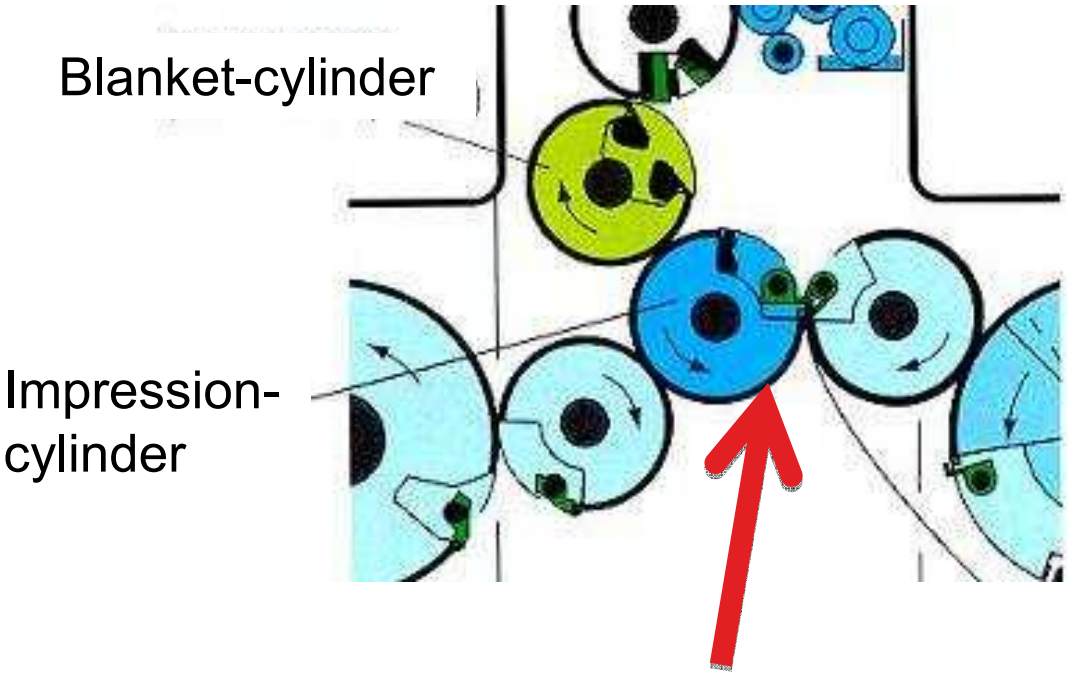




sheet transport

Impression-cylinder surface





Requirements:

- Ink repellent
- No print quality disturbance
- Fixing the paper during the print process
- **Wear resistance**
- Corrosion resistance
- Easy-to-clean

„New Materials and Principles for Transport Surfaces in Printing Machines“

Project goal

Improvement of the wear resistance

of antiadhesive transport surfaces in offset printing machines

Transport surfaces

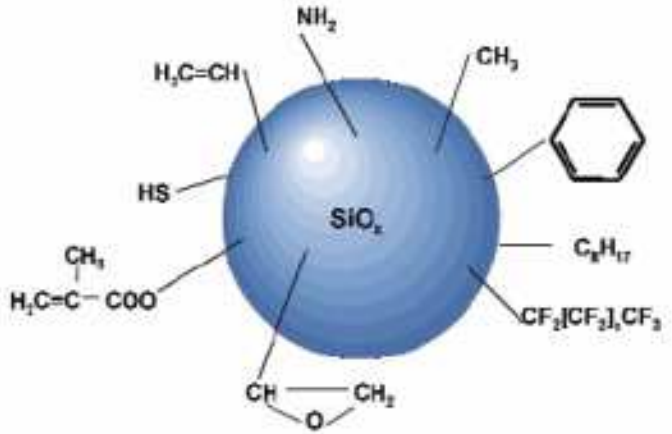
Development: Combination of structure and coating

structure

- Galvanic forming
- Thermal spraying
- Blasting
- Galvanic coating
- Foil
- Laser structuring
- Cut/Grinding

low surface energy

- Silicone
- Functionalised polysiloxane
- Fluorine-substituted polymer



Source: FEW Chemicals

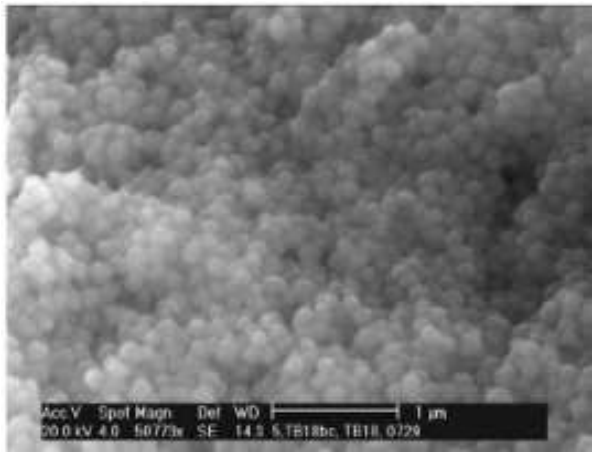
Material properties

- Low surface energy
- Good adhesion to the substrate
- High resistance against cleaning agents
- UV-resistance
- Temperature resistance up to 150°C
- ***Wear resistance***

Source: FEW Chemicals

Approach: SiO_x/SiCN-based hybride coatings

- SiO_x-***Nanosole (particle size ~15 nm)***
- $[Si(NCN)_2]_n$-***Nanopowder (particle size ~60 nm)***
- Application *via* doctor blading or spray coating



Source: TU Darmstadt

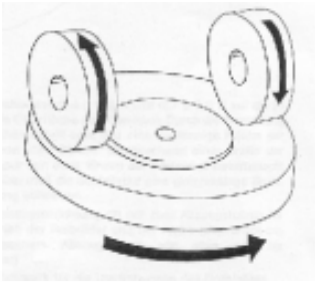
Results: anti-adhesive / ink repellent properties

- SiO_x-based coatings: hydrophobic and oleophobic
- $[Si(NCN)_2]_n$ does not negatively affect the anti-adhesive properties

SiO_x-Solsystem	$[Si(NCN)_2]_n$	RW (H_2O) [°]	RW (HD) [°]
H 5044	---	109	67
	0,05g / 100ml	110	67
	0,1g / 100ml	111	68
H 5055	---	111	68
	0,05g / 100ml	111	69
	0,1g / 100ml	111	68
H 5057	---	111	68
	0,05g / 100ml	112	68
	0,1g / 100ml	111	67

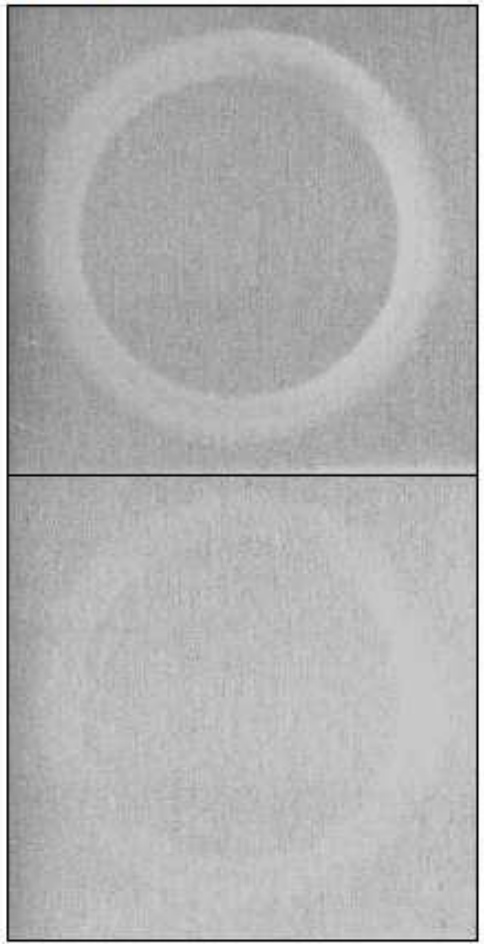
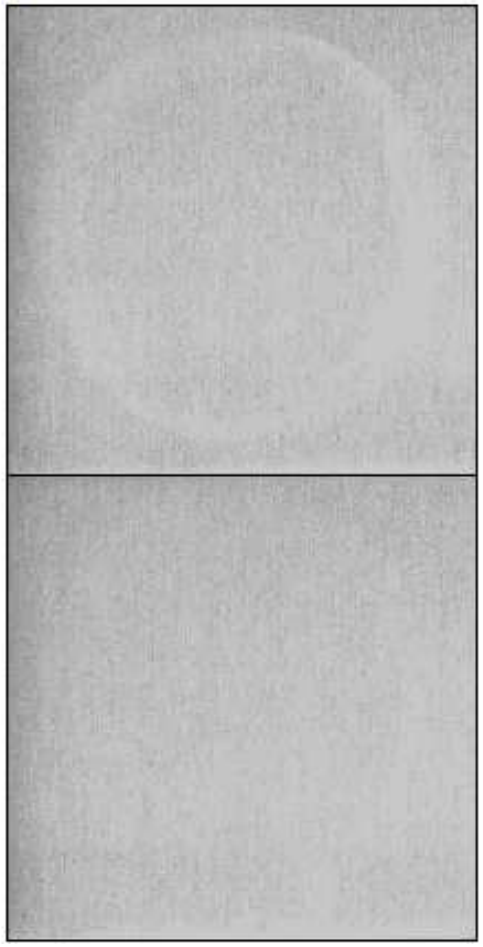
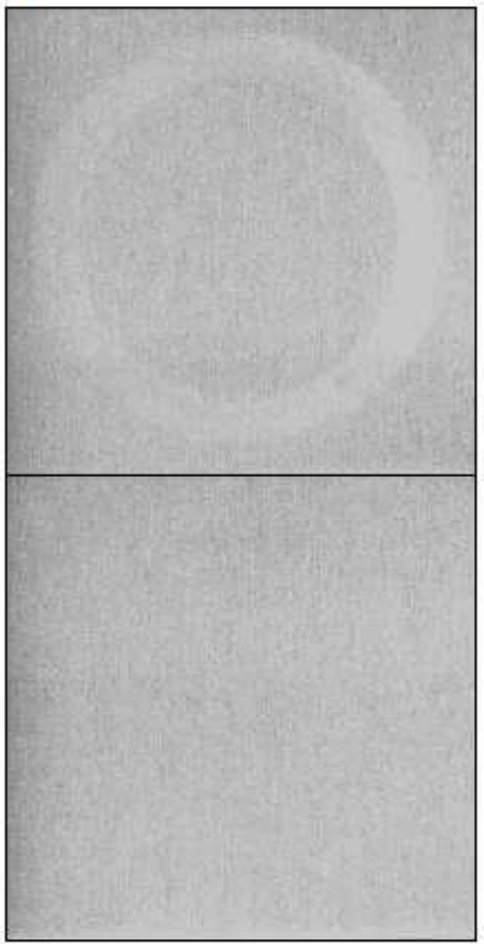
Source: FEW Chemicals

Results: Wear resistance

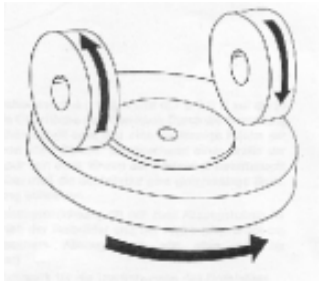


Test system: TABER ABRASER

FEW CHEMICALS

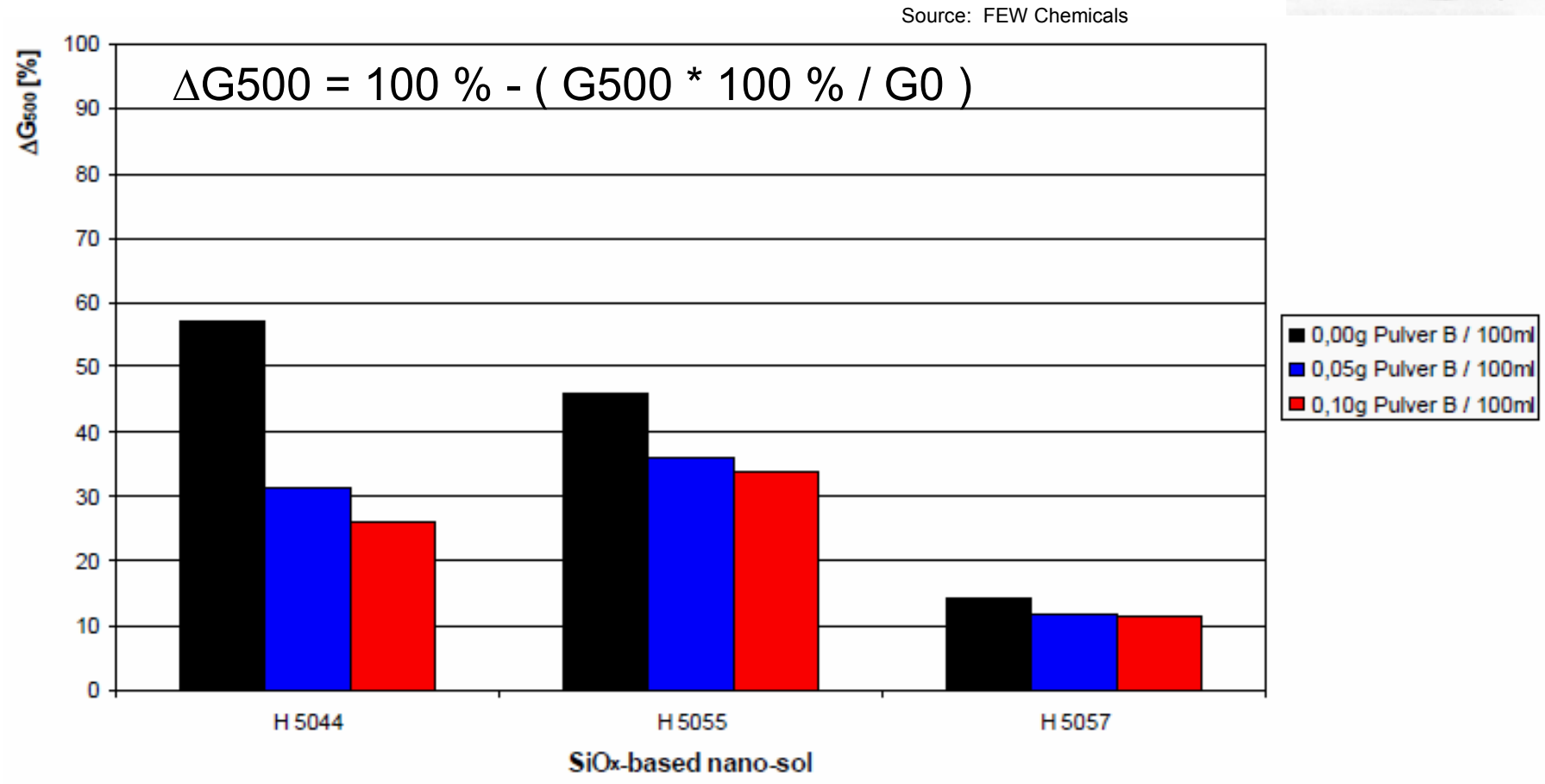
H5044	H5055	H5057	
			Without nano-particles
			With nano-particles

Results: Wear resistance



Quantification (using gloss values before and after wear)

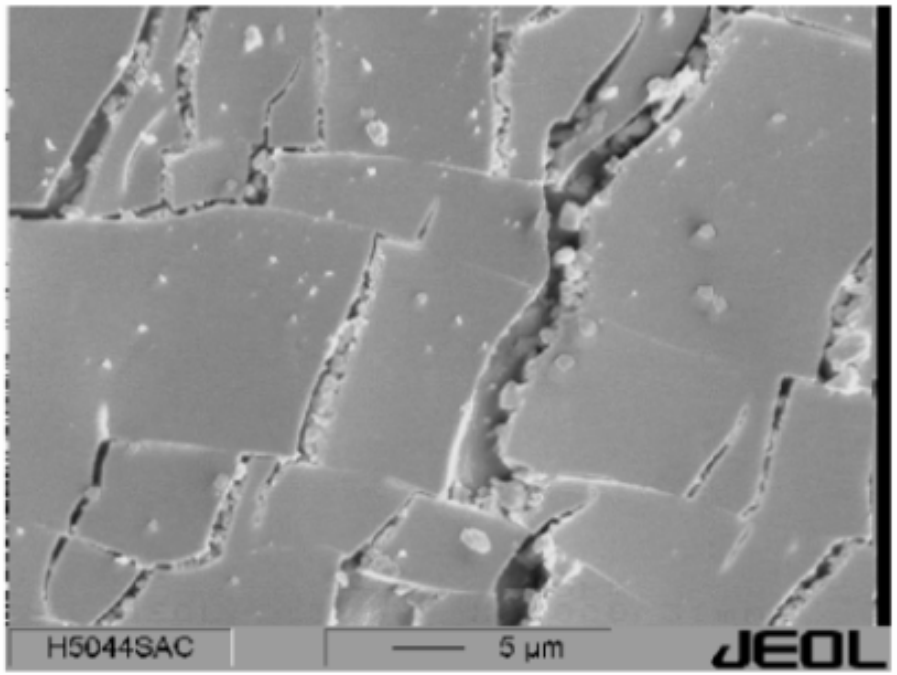
Source: FEW Chemicals

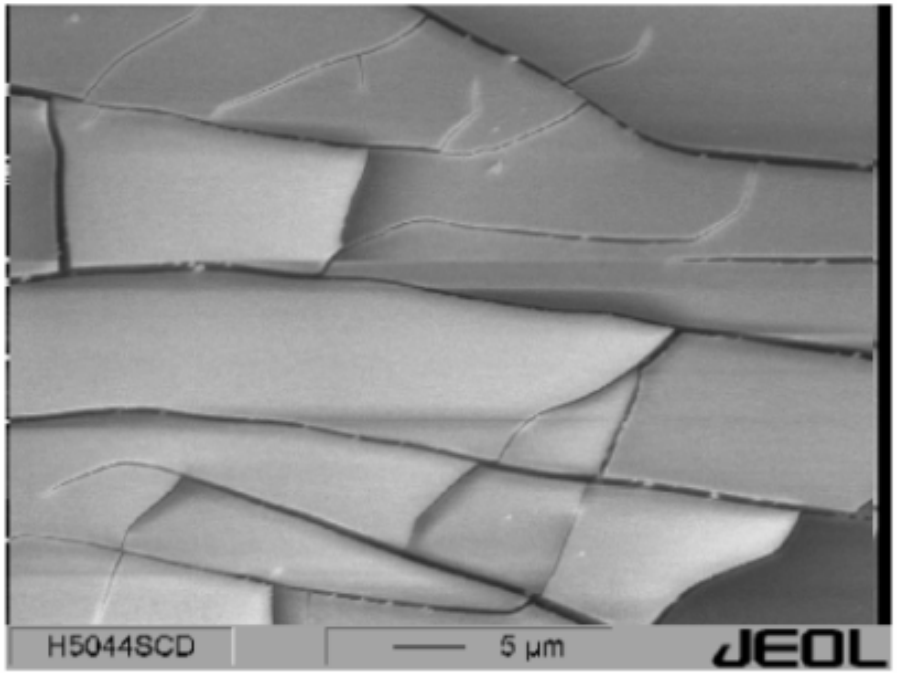


G0: gloss value without wear

G500: gloss value after 500 cycle TABER ABRASER

Results:
Influence of temperature on the degree of cross-linking



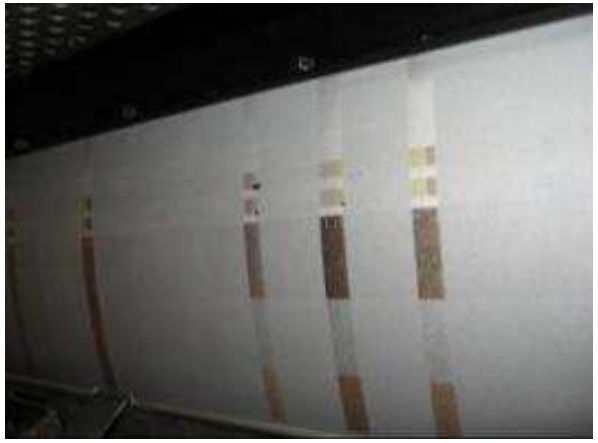


Source: TU Darmstadt

SiO_x –based coating (15 min, 130°C – left, 180°C – right)

Results: Application of coatings on structured metallic substrates (technical surface)

- Positive application on structured metal sheet
- Improved wear resistance (difficult characterisation because Rz > coating layer)
- Upscaling to 1m² achieved
- The use of nanoparticles does not induce changes in the print quality

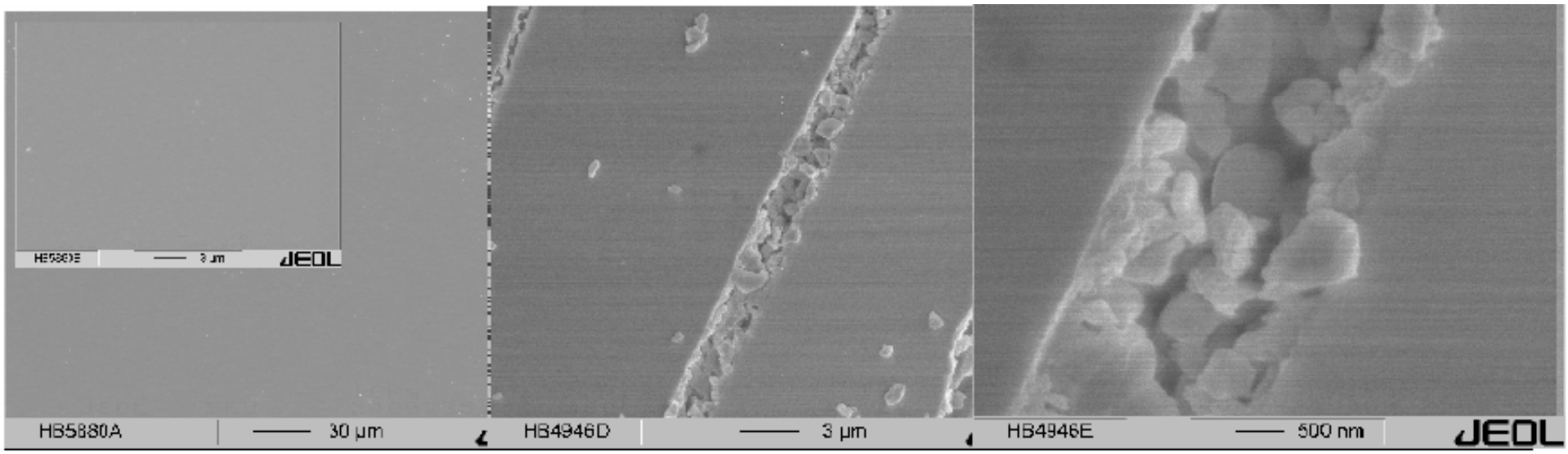


Summary

- Novel nanostructured SiO_x/SiCN-based hybrid films were synthesized and coated – transparent and crack-free.

- In some cases particulate structures were identified under the plane surface, due to the fact that the cross-linking process was not complete. (particle size:100-300 nm)

- Coatings are antiadhesive/ink repellent (hydrophobic and oleophobic behavior) and exhibit **improved wear resistance** (up to 50% improvement) with respect to the analogous non-modified SiO_x-coatings



Source: TU Darmstadt

Future challenges

1. How are the nanoparticles build in / incorporated in the coatings?
2. Prozess optimization for a stable reproducibility
3. Upscaling issues
4. Examination of the coating bonding to the substrate vs. wear resistance of the coating itself.

Thanks

TU Darmstadt, Dr. E. Ionescu, Prof. Dr. R. Riedel

FEW Chemicals, M. Zschuppe, Dr. J. Harenburg

BMBF, Projektträger Jülich, Dr. E. Gerhard-Abozari

TECHNISCHE UNIVERSITÄT DARMSTADT

FEW CHEMICALS

GEFÖRDERT VOM

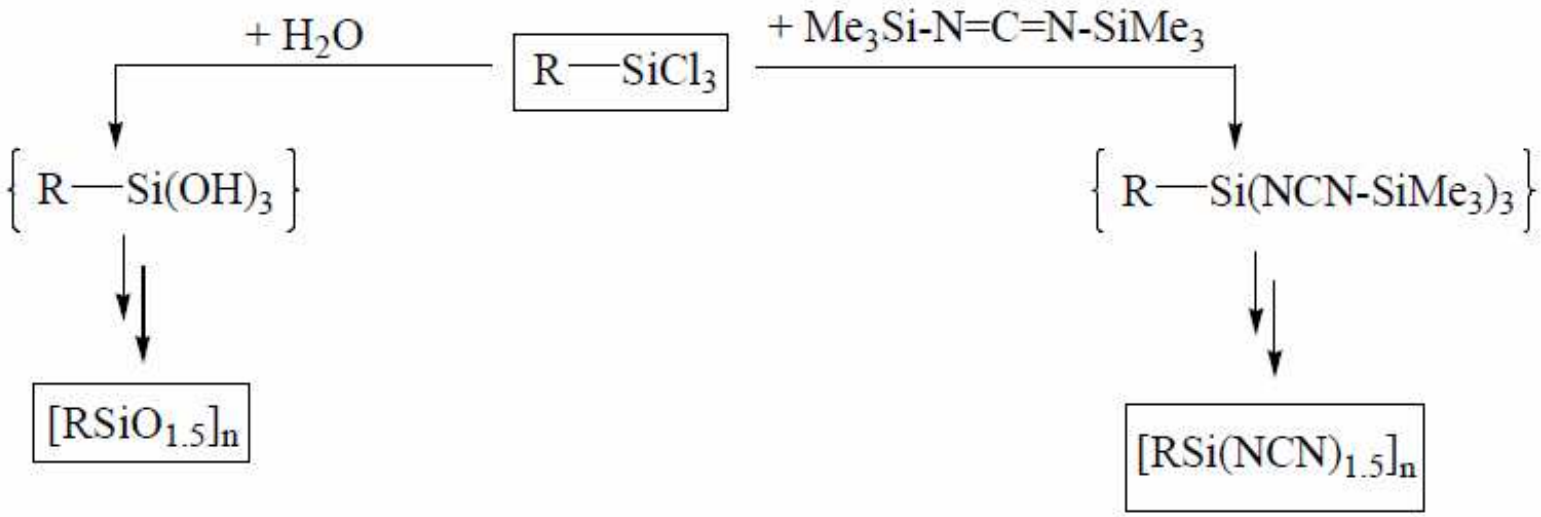
Bundesministerium für Bildung und Forschung

Thank you for your attention!

3. Poly[(silyl)carbodiimid]-basierte *Nano*pulver

TECHNISCHE UNIVERSITÄT DARMSTADT

Oxidischer Sol-Gel-Prozess **Nicht-Oxidischer Sol-Gel-Prozess**



Stöber-Process

Hydrolyse von verdünnten Wasser/Alkohol-Lösungen von TEOS (bei hohen pH-Werten) – SiO_x-*Nano*partikel

W. Stöber, A. Flink, E. Bohn, *J. Colloid Interface Sci.* **1968**, *26*, 62.

Nicht-oxidischer Stöber-Prozess

Reaktion von Organylchlorsilanen mit Bis(trimethylsilyl)carbodiimid in verdünnten Lösungen (THF, Toluol) – $[Si(NCN)_2]_n$-*Nano*partikel

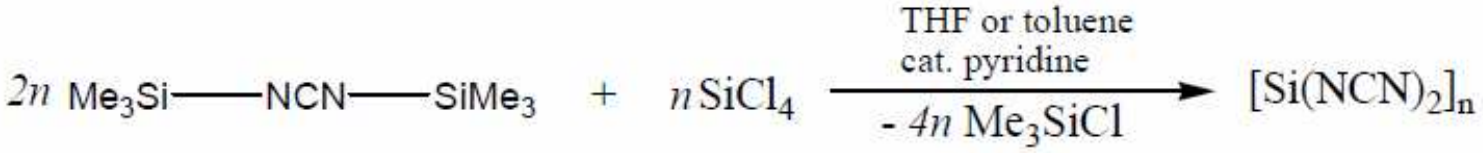
Y.-L. Li, E. Kroke, A. Klonczynski, R. Riedel, *Adv. Mater.* **2000**, *12*, 956

Förderkennzeichen 03X0017

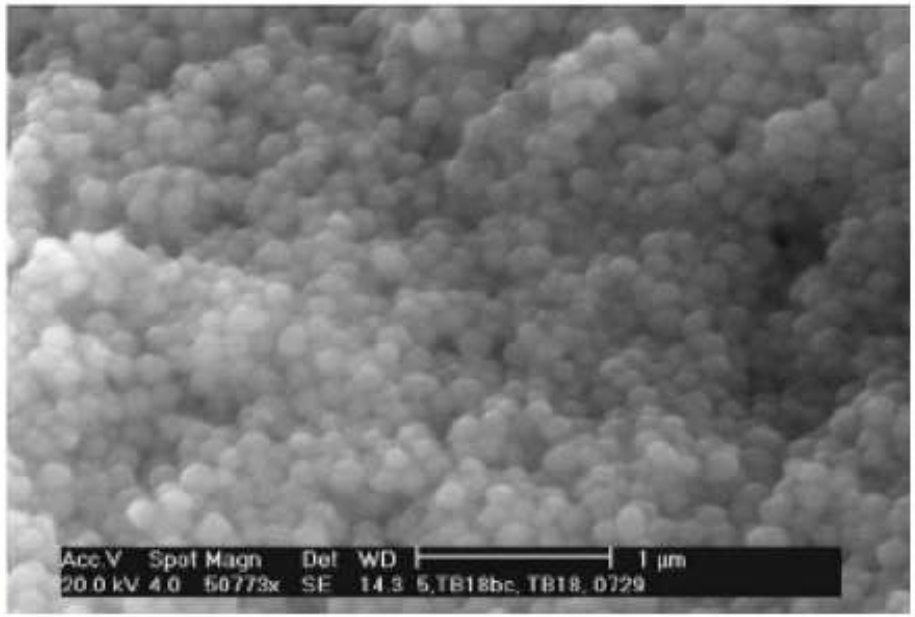
3. Poly[(silyl)carbodiimid]-basierte *Nano*pulver

TECHNISCHE UNIVERSITÄT DARMSTADT

$[Si(NCN)_2]_n$ *Nano*pulver *via* non-oxidischem Stöber-Prozess



- Entfernung von Me_3Si-Endgruppen – 350 °C im *Vakuum*
- Pyrolyse – zwischen 600 °C und 800 °C
- $[Si(NCN)_2]_n$-*Nano*pulver (Partikelgröße ~ 60 nm)



Y.-L. Li, E. Kroke, A. Klonczynski, R. Riedel, *Adv. Mater.* **2000**, *12*, 956

Förderkennzeichen 03X0017