Photocatalytic Coatings

Hydrophilic vs. Photocatalytic

Hydrophilic Coatings

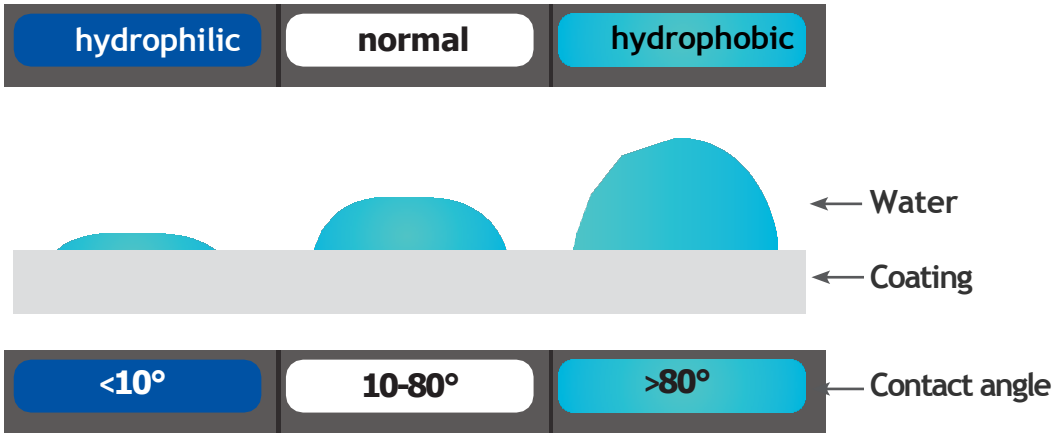
(passive Self-cleaning)

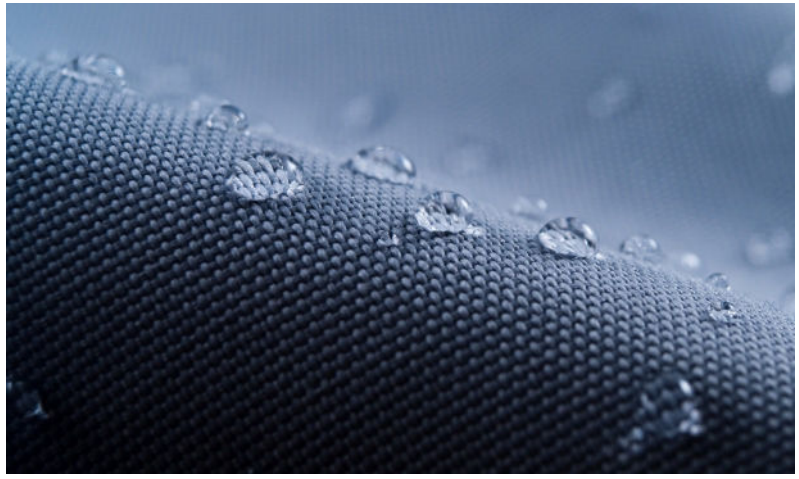
Photocatalytic hydrophilic Coatings

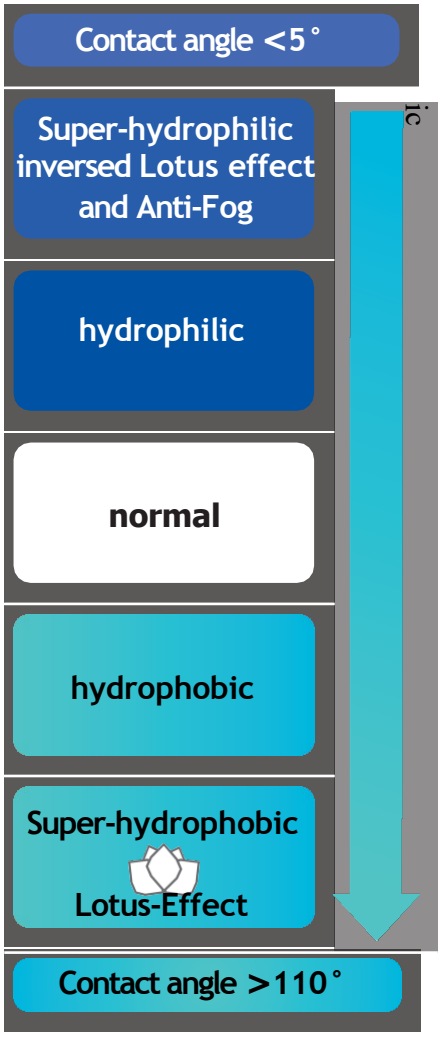
(active Self-cleaning function)

Contact angle

Hydrophilic - Hydrophobic



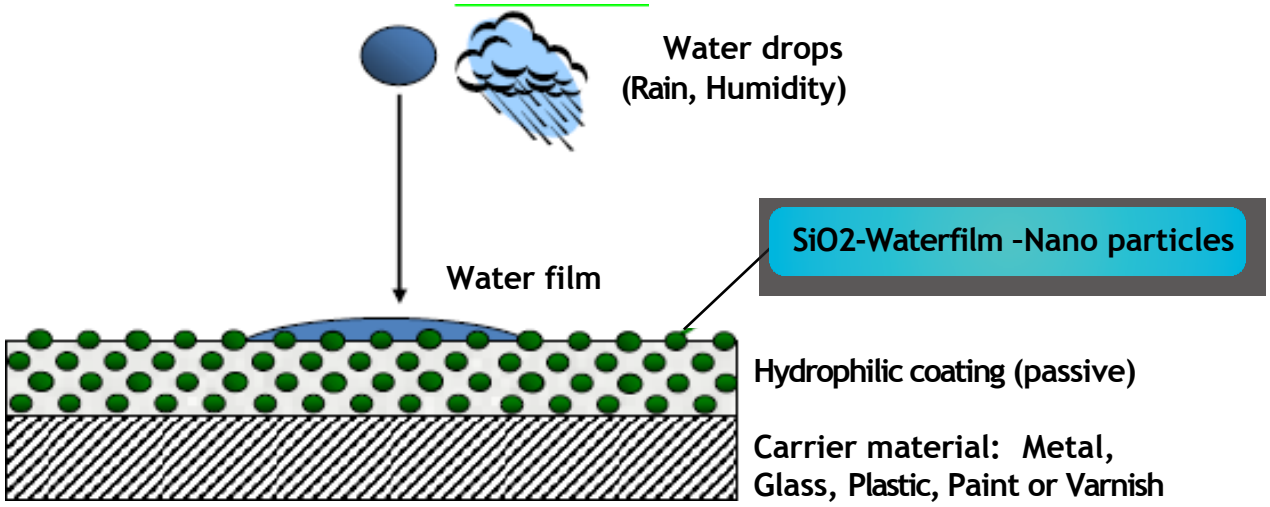




Passive self-cleaning Coating

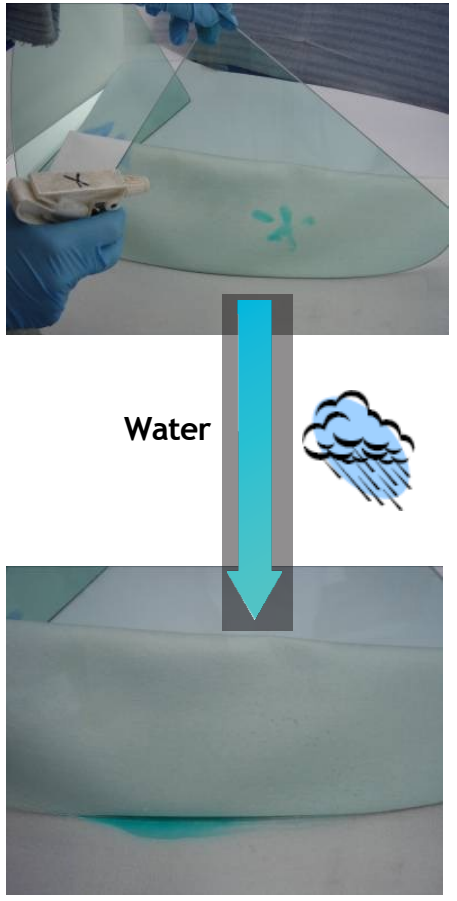
Hydrophilic Coating

Super hydrophilic Properties



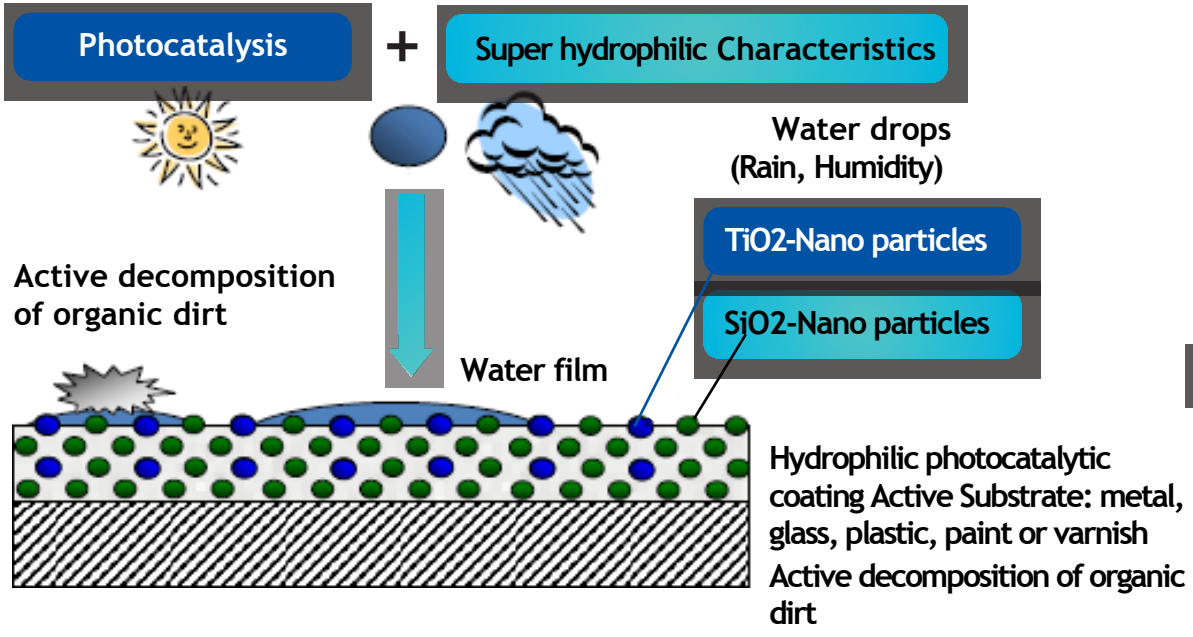
- SiO2 nanoparticles in a siloxane matrix with hydrophilic properties.
  Dry coating thickness 0.5 to 1 µm
  No organic surfactant groups => UV-stable, suitable for indoor and outdoor use
  Nanostructures in the 20 to 50 nm range offer self-cleaning properties
  Structure like lotus leaf but super hydrophilic (not super hydrophobic)
  => "reverse lotus effect"
  Undermining and flushing away inorganic/organic dirt and soil.
  Carrier material: metal, glass, plastic, paint or varnish

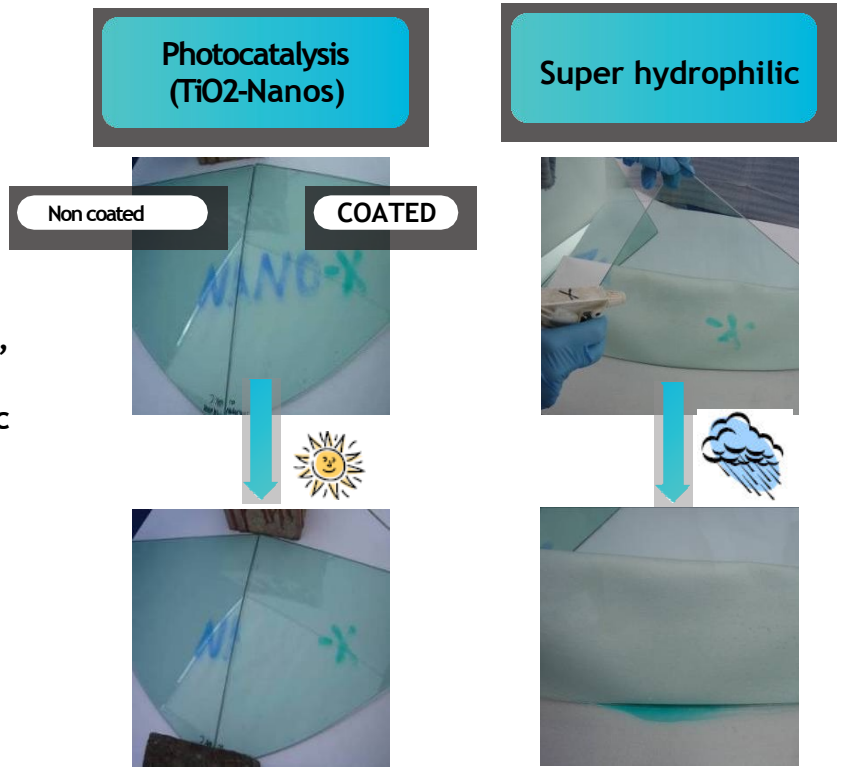
Super hydrophilic



Active self-cleaning Coating

Photocatalytic (hydrophilic) coating





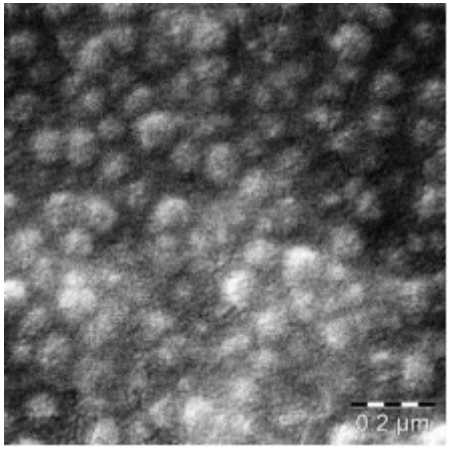
- Coating properties similar to a purely hydrophilic coating
- Nanostructure in the range from 20 to 50 nm => "inverse lotus effect" / super hydrophilic self-cleaning coating
- Undermining and rinsing off inorganic/organic dirt

- PLUS: additional photocatalysis with TiO2 nanoparticles :
  UV light (direct/indirect sunlight)
  Decomposes organic impurities in the adhesive with TiO2

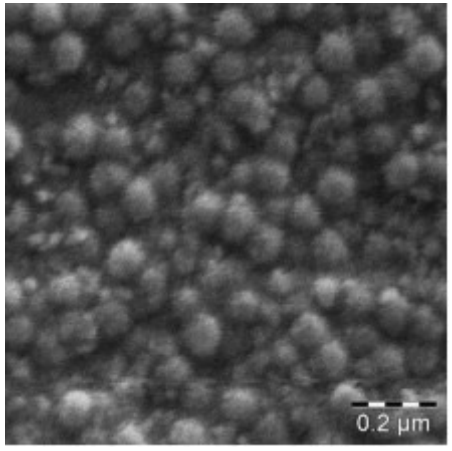
SEM-Picture

Photocatalytic Coating

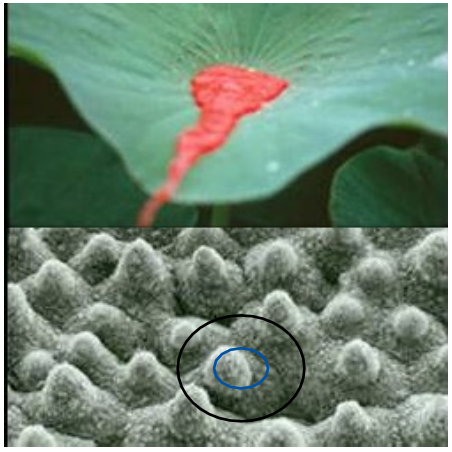
SEM-Picture of a photocatalytic coating with Nano structuring



before a QUV-A test (accelerated weathering test with UVA irradiation)



after 500 hours of QUV-A testing



Source: Prof. Barthlott, University Bonn

- TiO 2 and SiO 2 nanoparticles in a siloxane matrix
  Distance between peaks in the range of 50 nm (nanostructure)
  the hydrophilic surface structure resembles the hydrophobic structure of the lotus leaf
  => inverse lotus effect
  Surface structure is weather-resistant in the QUV-A test

Photo catalytical Effect

Artificial Weathering

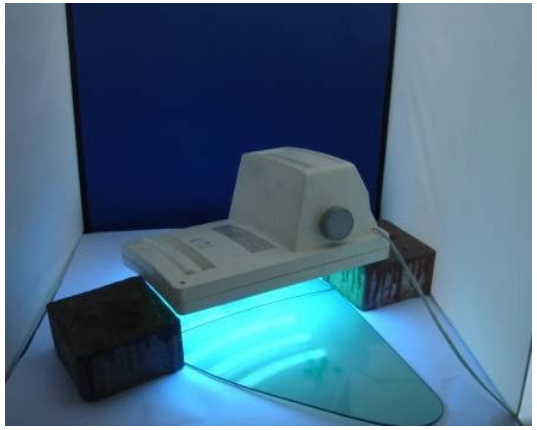
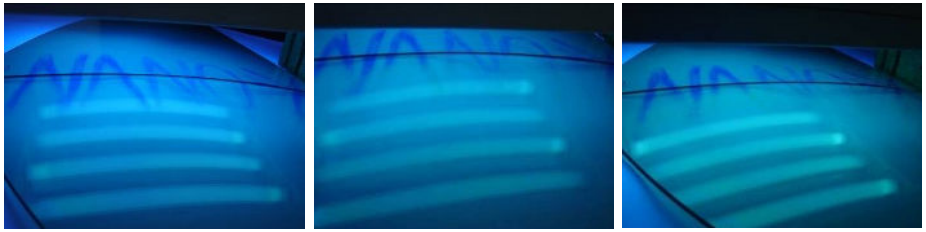


Photo catalytical activity

before UV irradiation

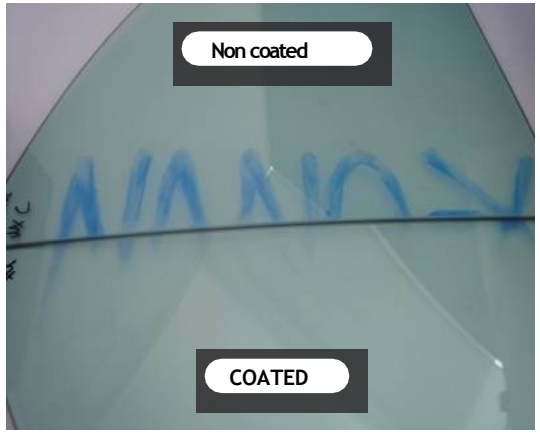
Active self-cleaning properties

Sunlight / UV radiation



1 Min 5 Min 10 Min

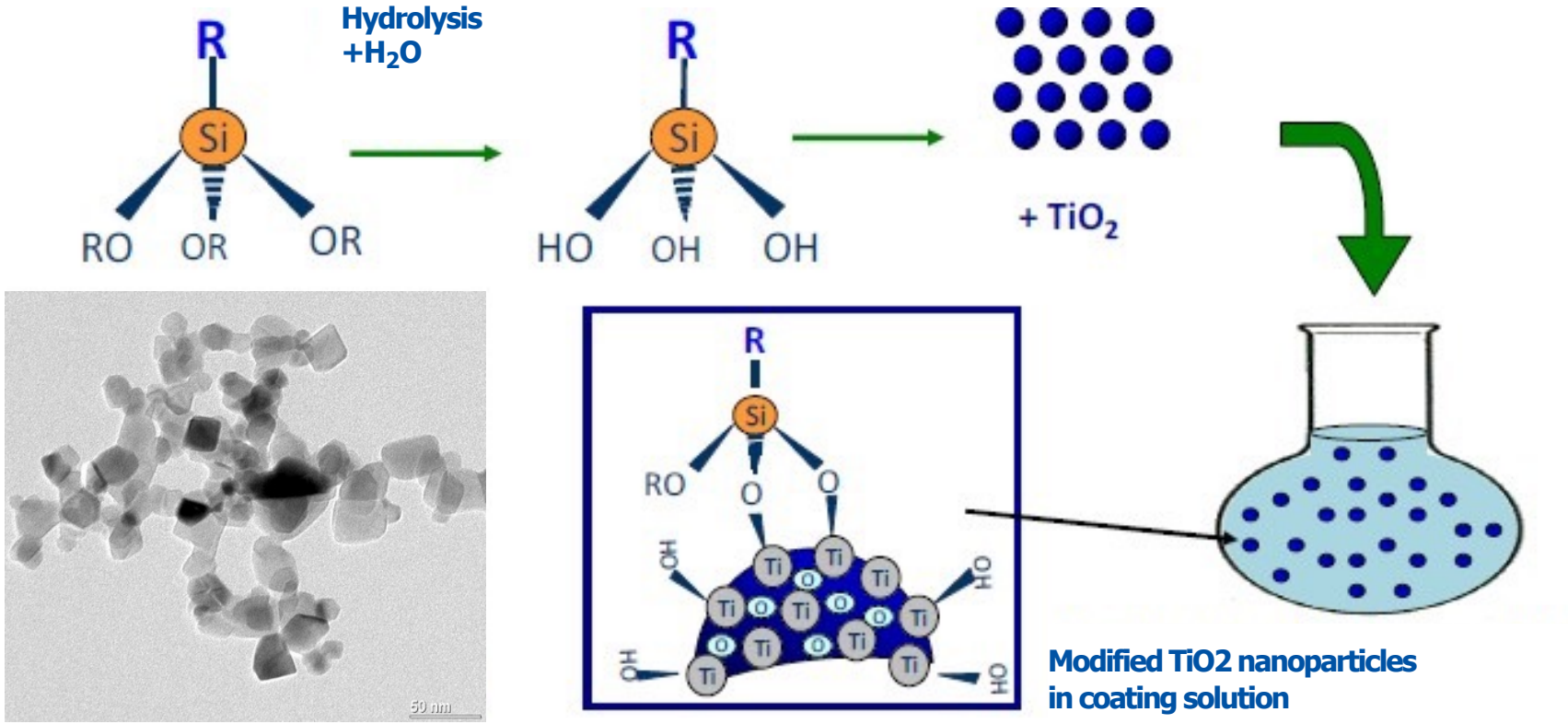
photocatalytic degradation of the dye in 15 minutes!



after 15 min UV irradiation

Technology

Chemical synthesis



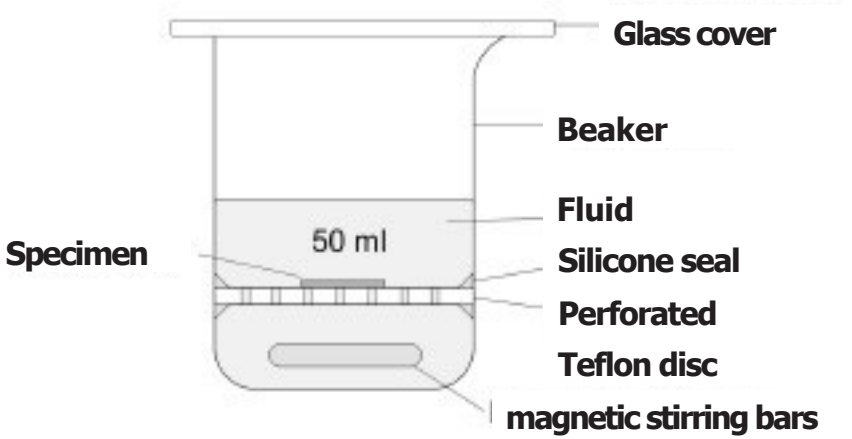
titanium dioxide nanoparticles.

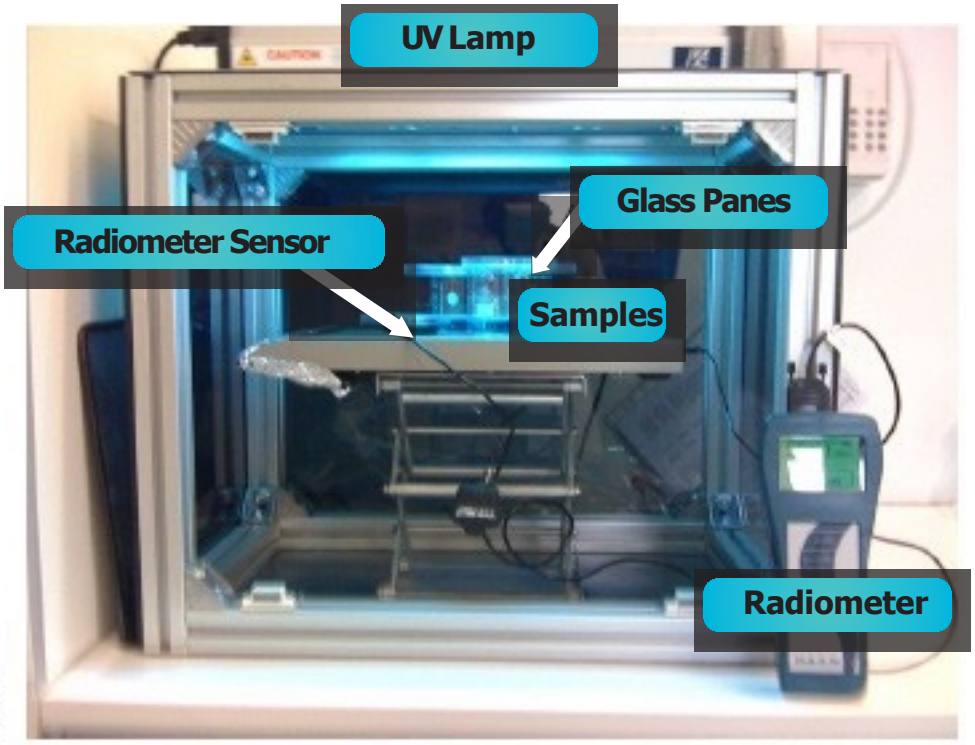
Source: Evonik (Degussa)

With sol-gel technology, nanoparticles can be surface-modified and stably dissolved in their primary particle form.
(no re-agglomeration)

Methylene blue degradation measurement

Photocatalytic activity - measurement setup at Fraunhofer UMSICHT



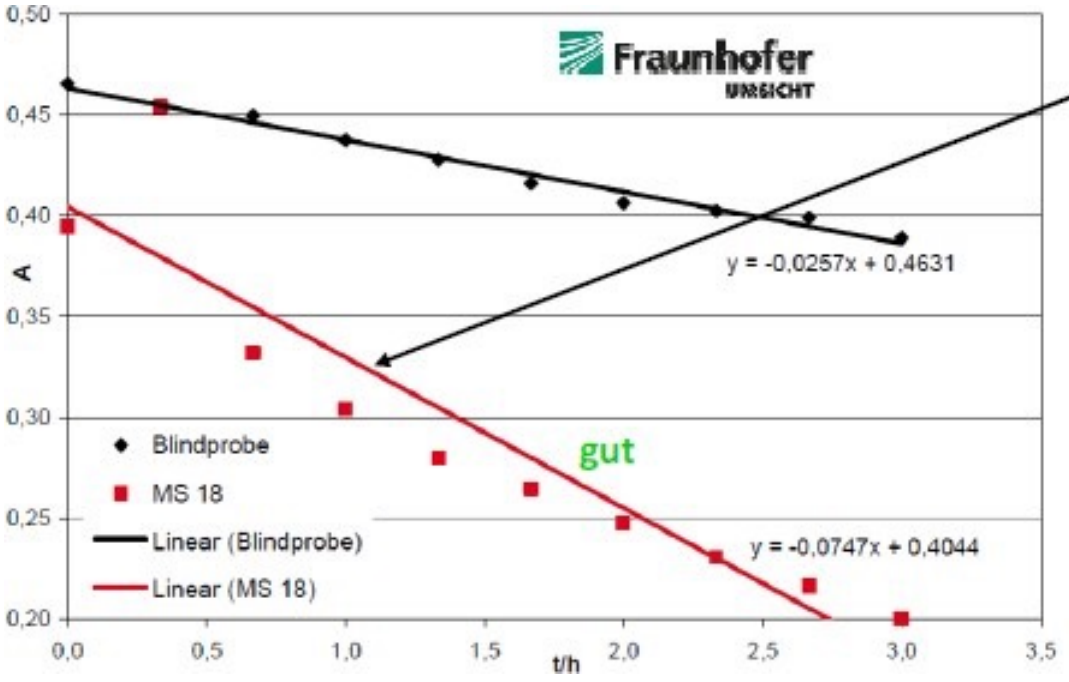


- UV radiation (10 W/m²): 365 nm and 254 nm
- methylene blue (10 µmol/l)
- Samples: coated micro sieve and uncoated blank

Photo activity

Measurement by Fraunhofer UMSICHT

Test parameters 10 µmol/l, 50 ml 2x2 cm², average of 3 measurements



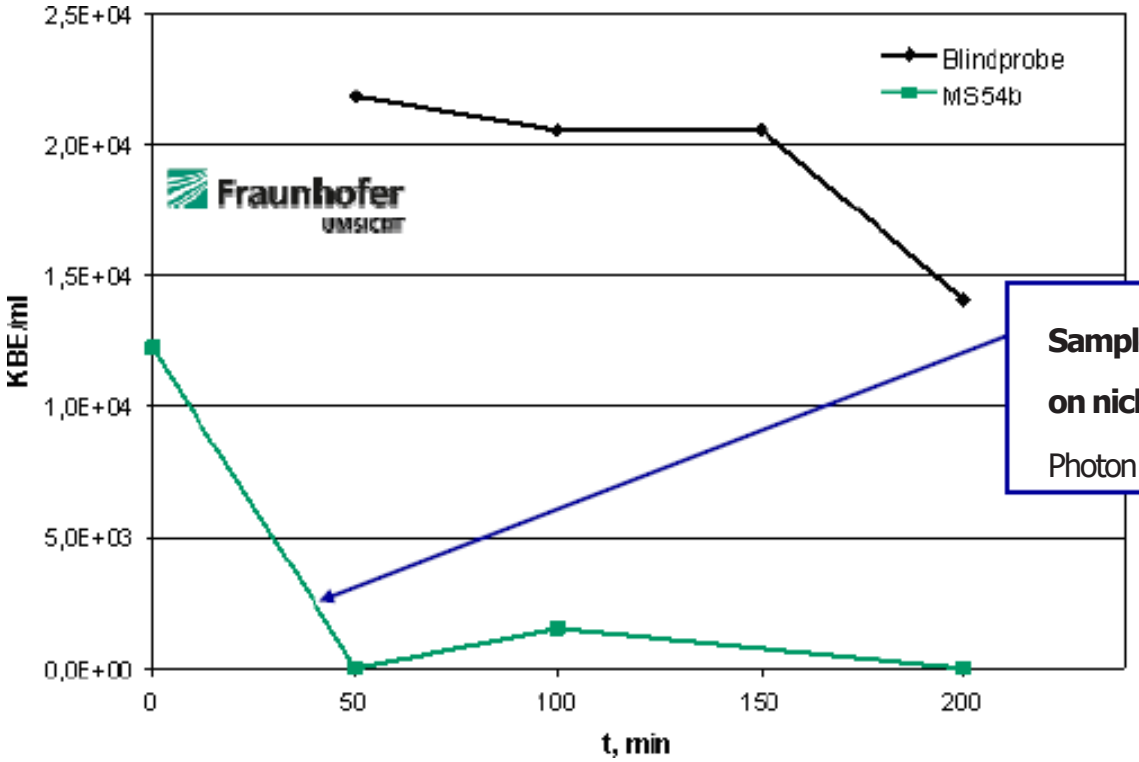
Sample "MS18"
underlayer VP CO 7964 +
Upper class VP PK moe1020
Photon efficiency: 0.133%

photon efficiency :
MS 18: 0,1326 %

Bactericidal Effect

Measurement by Fraunhofer UMSICHT

Bactericidal effect according to DIN 8199: evaluation after 72 hours



Sample "MS54"

on nickel screen holder

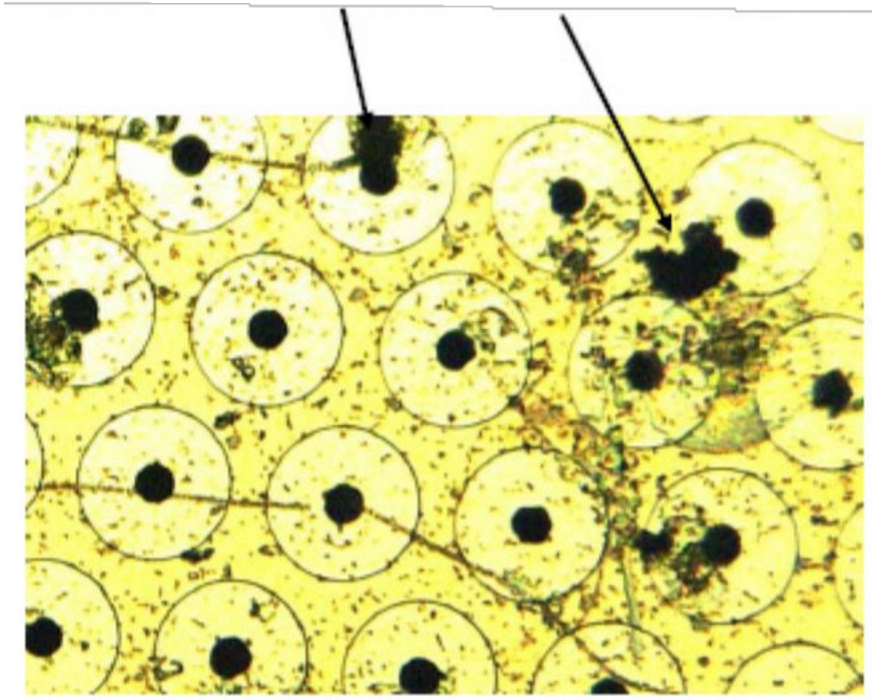
Photon Efficiency: **0.155%**

Micro sieve Photon Efficiency.
MS 54 0,155

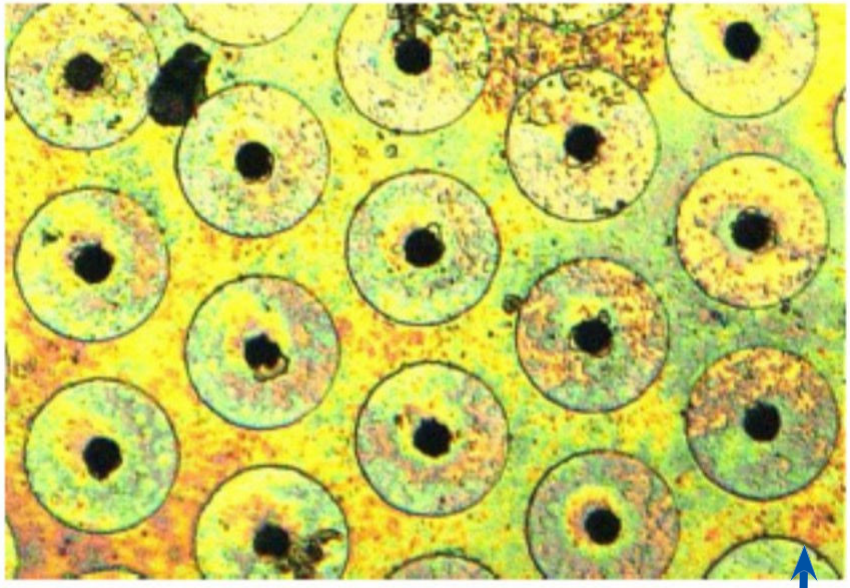
Antifouling-Effect

Measurement by Fraunhofer UMSICHT

Activated sludge degradation: 12 days of continuous UV irradiation



Micro sieve without coating



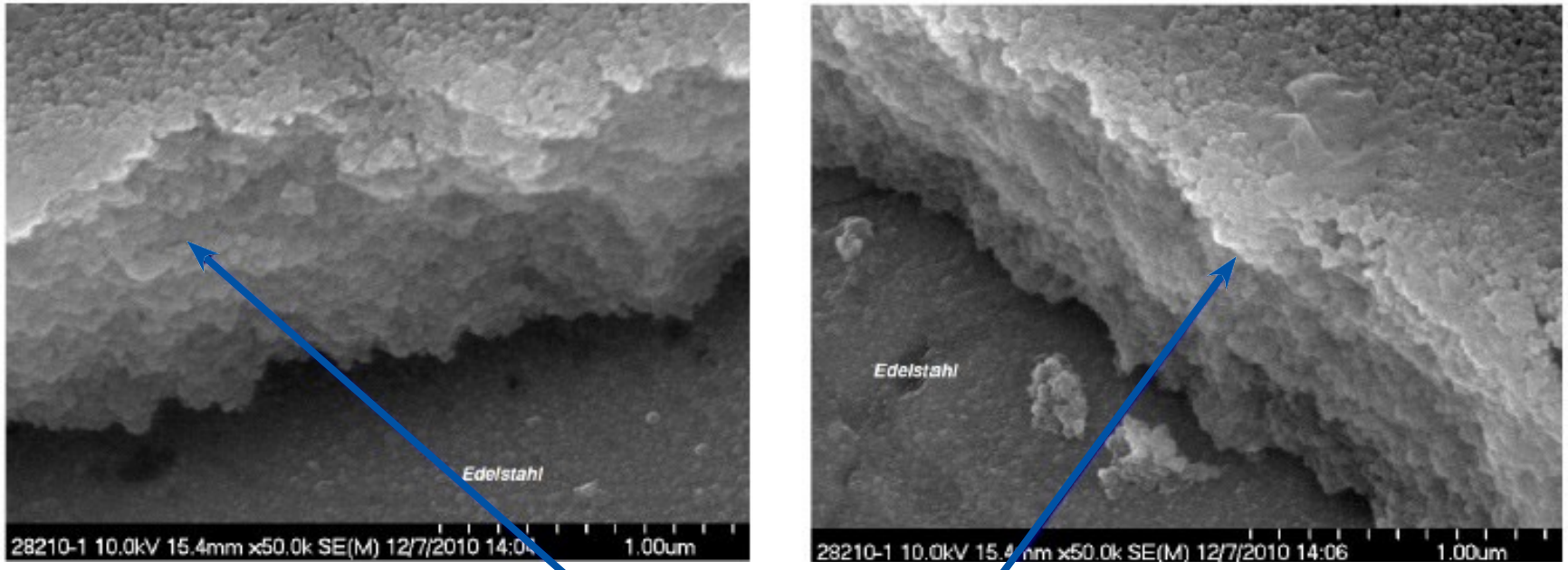
Micro sieve with titanium dioxide coating

Photocatalytic coating on nickel portafilter

Structure in the electron microscope

SEM recording from Fraunhofer UMSICHT

2010024997/3 stainless steel 5x5cm with VP PK 1442
(Ch. 20101006_Moe915)
hardened at 150°C; 15min +1h 300°C



Measurement of methanol degradation

Measurement of physical life

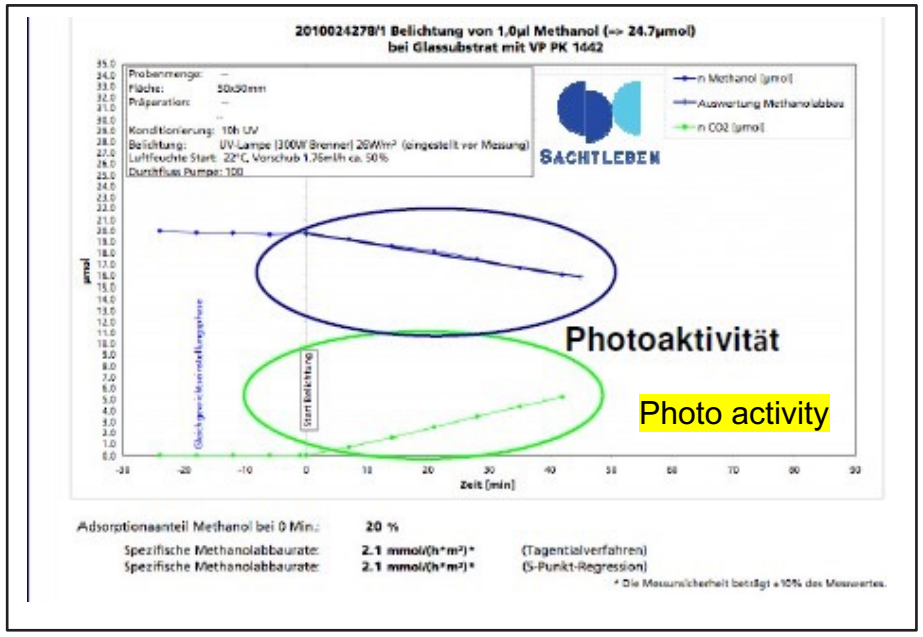


Photo activity

Before irradiation

And after UV irradiation

Photocatalytic layer VP PK 1442 on glass shows clear - Methanol degradation with formation of CO2 (measurement by Sachtleben)
Visible degradation of blue test dye by UV radiation from a commercially available facial tanner

Photo activity

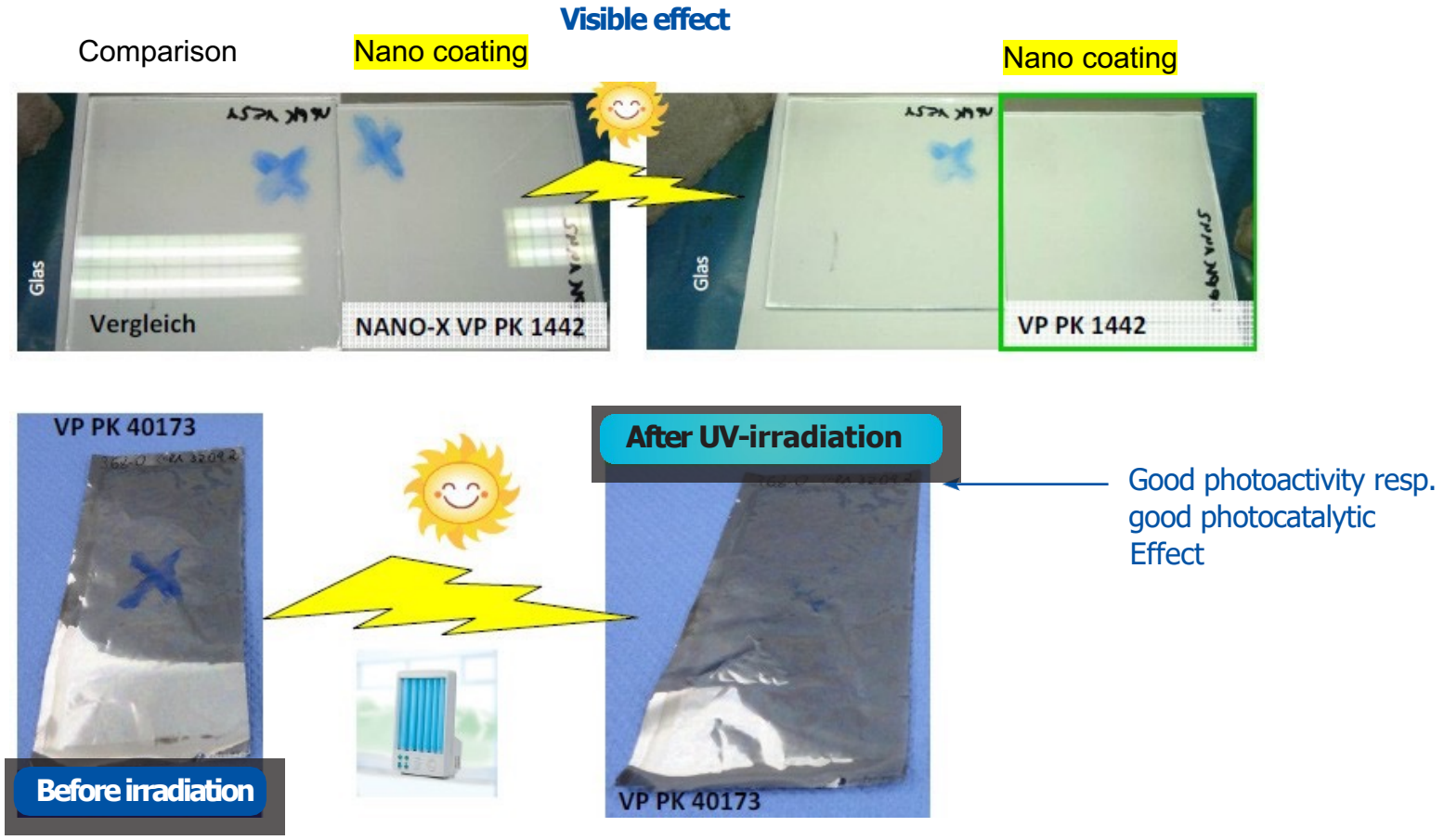
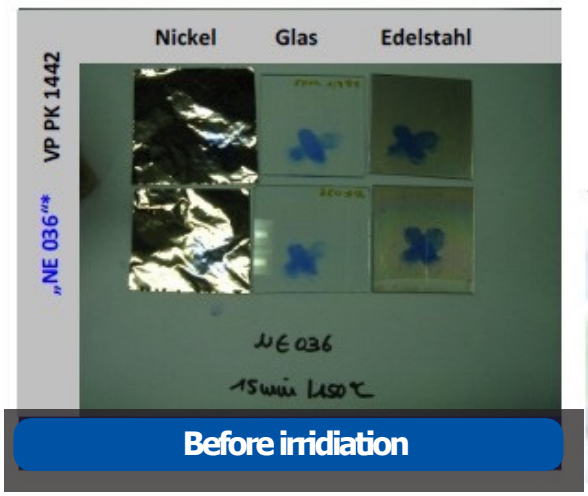


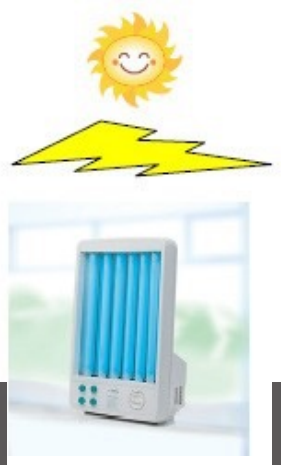
Photo activity

Visible Effect

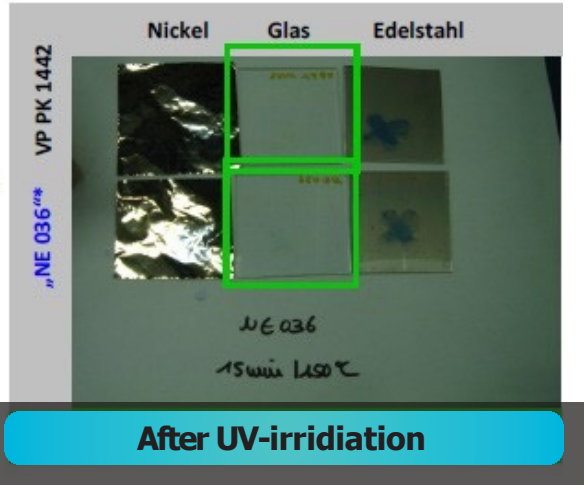
Nickel Glass Stainless steel



Before irridiation



Nickel Glass Stainless steel



After UV-irridiation

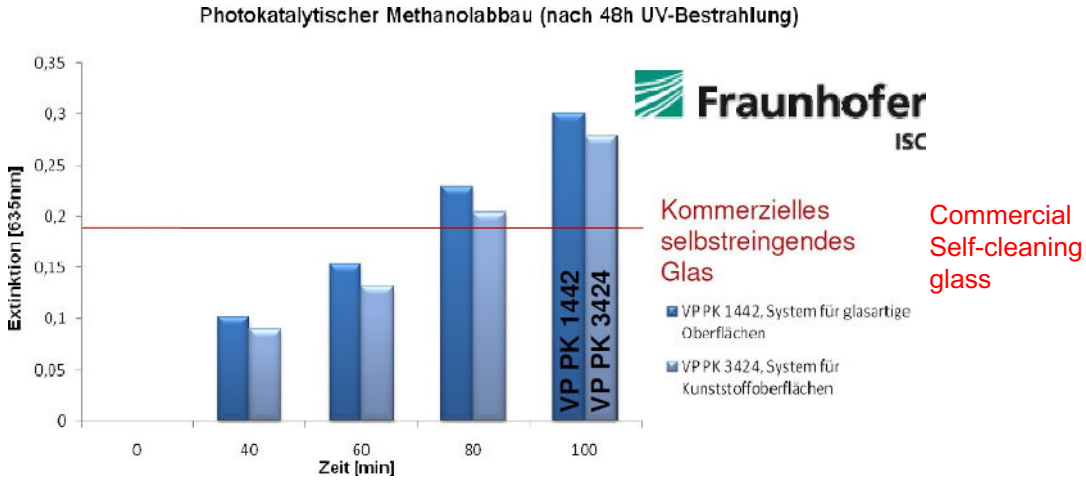
*"NE036" is a modification of
VP PK 1442 with photoactive ones
TiO2 nano particles as used in
x-view PK 1214 and x-view PK 1215

→ Comparably good photoactivity/ photocatalysis from VP PK 1442 and "NE036"

Measurement of methanol degradation

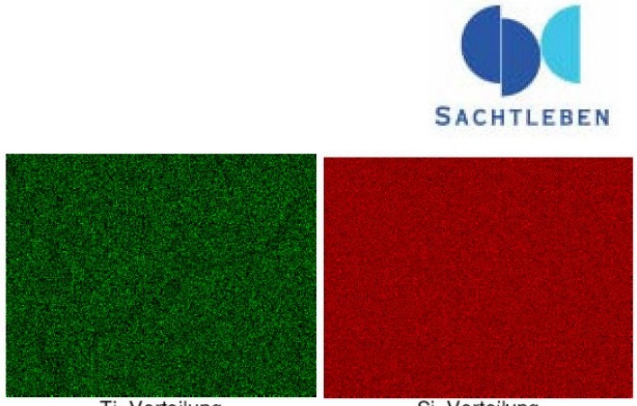
Measurements by Fraunhofer ISC and Sachtleben

Photocatalytic methanol degradation (after 48h UV irradiation)



Commercial Self-cleaning glass

Uniform distribution of silicon and titanium oxide in VP PK 1442



Ti distribution. Si distribution

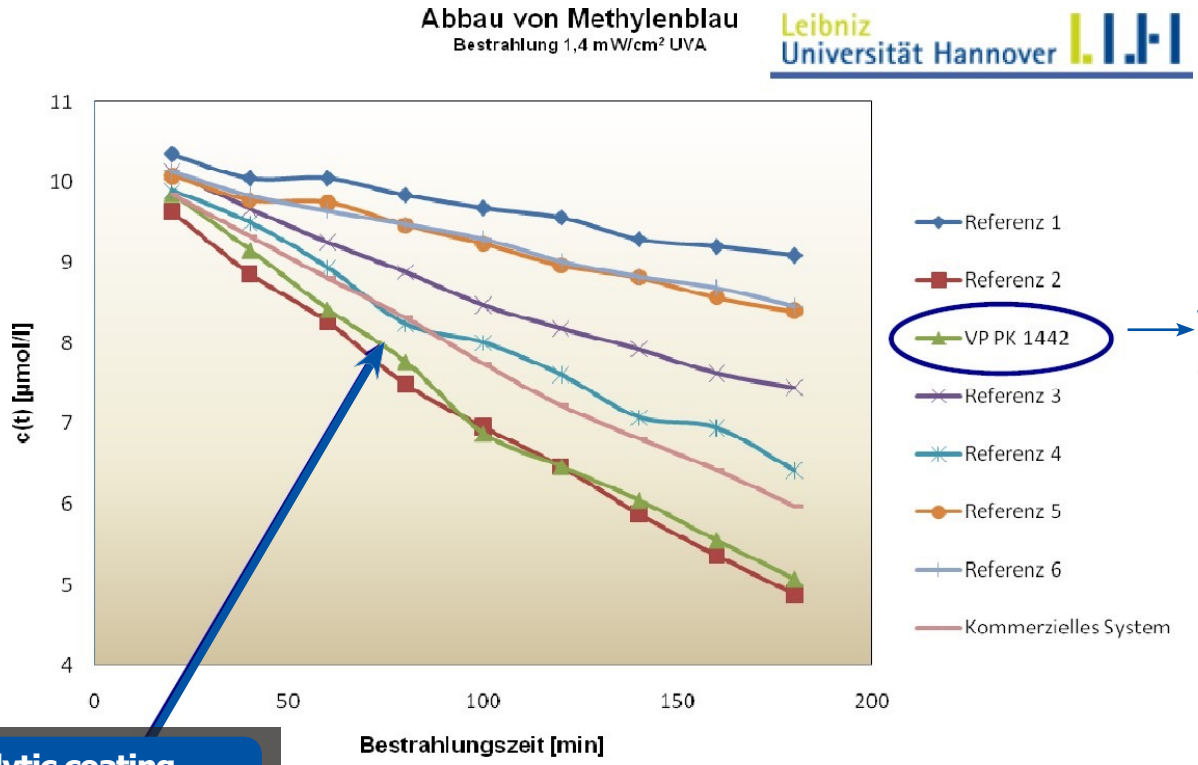
→ **Homogeneous distribution of the TiO2 nanoparticles in the VP PK 1442 coating and thus good accessibility of the titanium dioxide particles for organic dirt**

→ **Significantly increased activity compared to commercially available self-cleaning glasses**

Methylene blue degradation measurement

Measurements from the University of Hannover

Comparison of photocatalytic activity:



VP PK 1442 shows the best degradation behaviour in laboratory tests

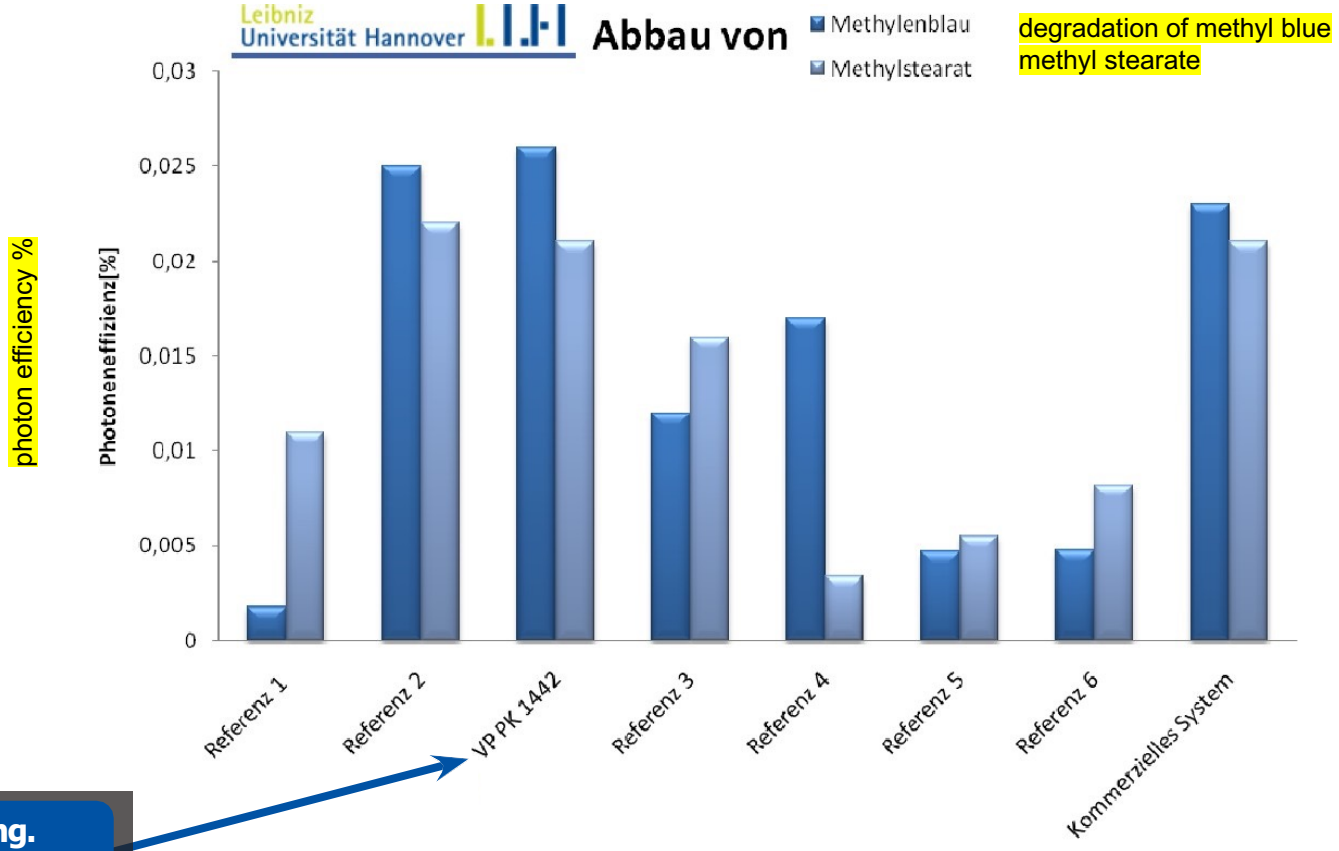
Photocatalytic coating. VP PK 1442 on glass

(BMW 3 series rear window)

Efficiency / photon efficiency

Measurements from the University of Hannover

Comparison of photocatalytic activity:



Photocatalytic coating.
VP PK 1442 on glass

(BMW 3 series rear window)

→ **VP PK 1442**
shows a very good efficiency in the UV-induced photocatalytic reaction

Contact Person

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