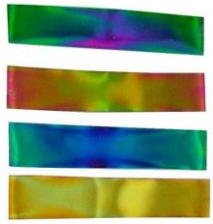
Nanotechnologie in der Anwendung – was tut sich in den Unternehmen?

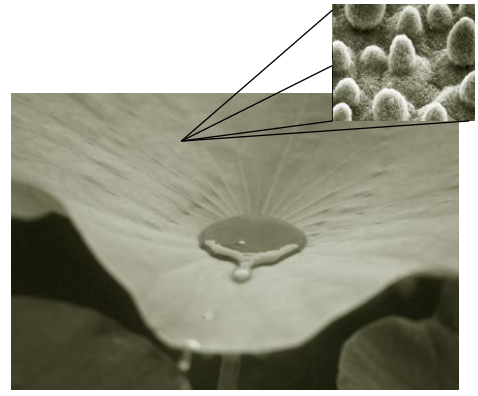
Andreas Kornherr, Gerhard Drexler, Paul Achatz

Nov 2009

Overview

- World‘s first Nano-hybrid laser copy paper
- New method to measure paper (nano)dust
- Smart pigments





Nano-hybrid laser copy paper - targets

- To produce a paper with
  - Excellent print quality in electrophotographic printers
  - Silky gloss
  - High whiteness level and light fastness
  - Higher bulk than coated papers
  - Improved adhesion of liquid toners (e.g. HP Indigo)
- Surface application in an online film-press
  - Limitation in coating weight
- Absolutely NO health hazard

Development strategy

- Use of synthetic polymer pigments
  - High glass transition temperature → no film formation
  - Thermoplastic deformation in the calender → gloss development at low calendering temperature and pressure
  - Lower density than clay
  - High brightness
- Increase of surface area by size reduction
  - 1 µm → 50 nm
  - High surface area with similar properties as toner should improve toner adhesion

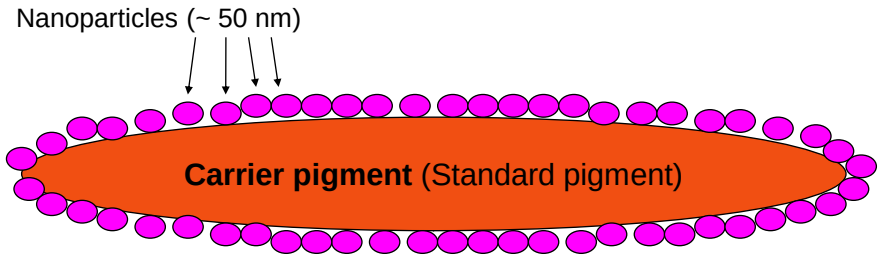
The problem:
This nano-pigment does not stay at the surface!

The solution: Nano-hybrid technology

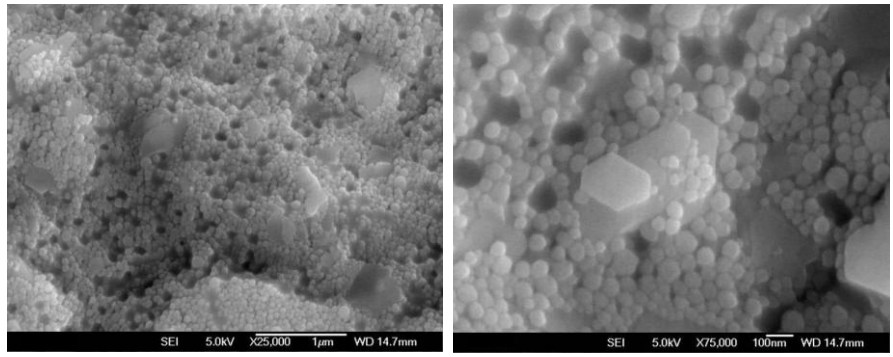
Nano-hybrid = Carrier pigment + Nanoparticles

- GCC
- Clay
- Al_2O_3
- Mica

- Polymer



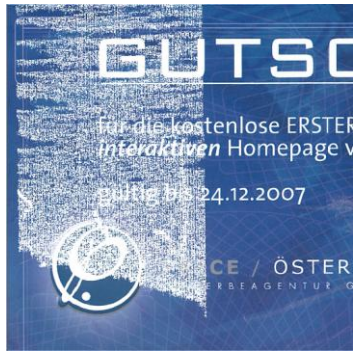
Nano-Hybrid



Particle size: ~50 nm

Images with kind permission by Topchim NV

Toner adhesion



Uncoated copy paper
premium quality
100 g/m²

Copy paper with
nano-hybrid
coating 110 g/m²

Measurement of (Nano)dust emissions

Need for

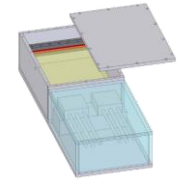
- new, high precision method allowing for the simultaneous determination of micro- and nanoparticle size distribution as well as the particle concentration

- good correlation with conventional dust tests of paper during the copy process

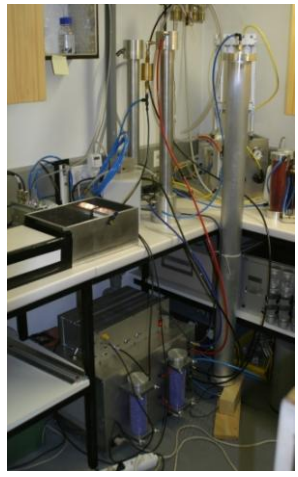
→ Development of the **NDT (NanoDustTester)**

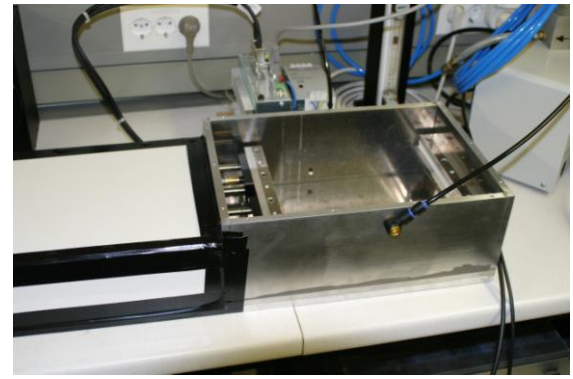
NDT measurement principle

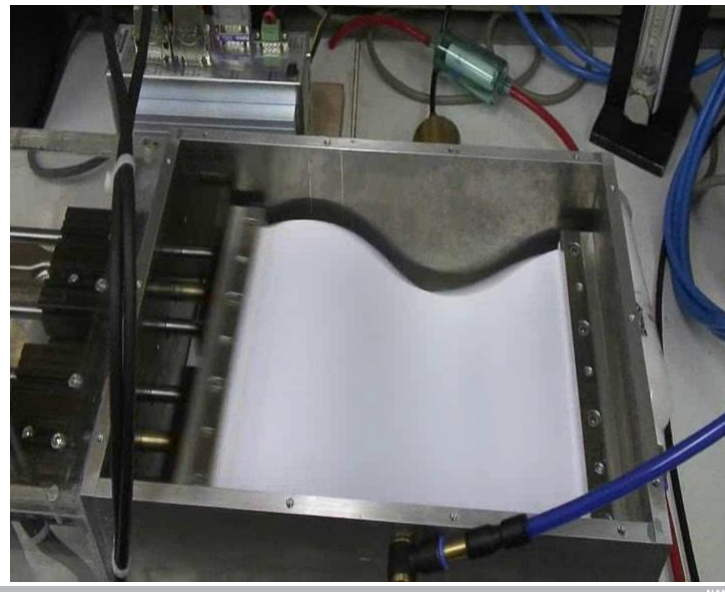
- Measurement of emissions from paper surfaces is carried out under reproducible mechanical stress
- Original idea: simulation of the handling of paper by human and/or mechanical operators
- Periodic folding (frequency: 2-6 Hz, amplitude: 2 cm)
- Testing of both virgin and crumpled paper sheets



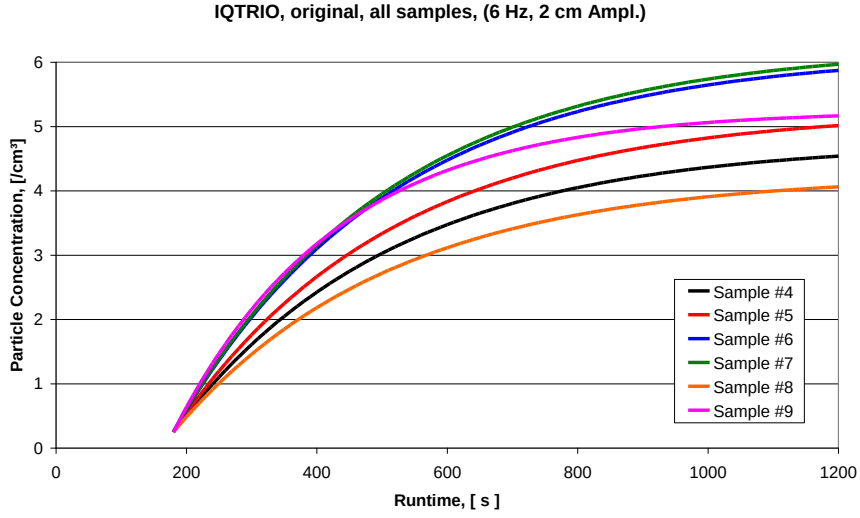
NDT measurement design



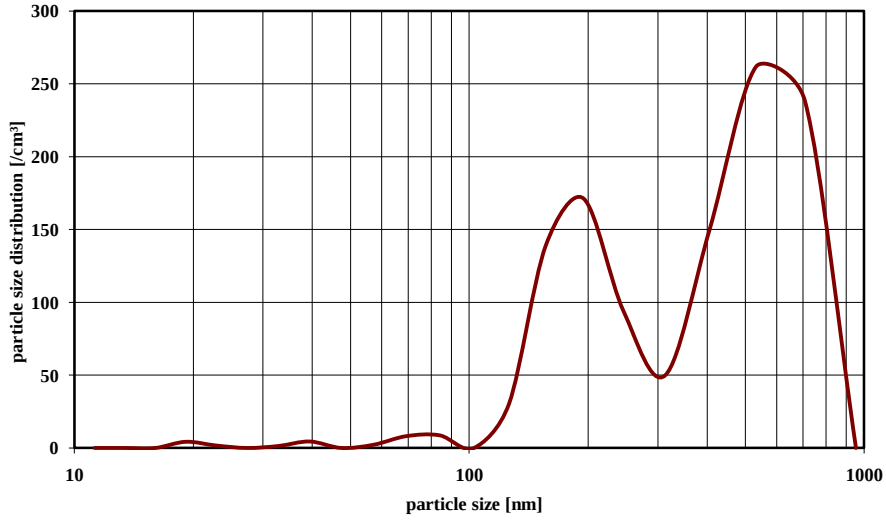




A+ copy paper


IQTRIO, original, all samples, (6 Hz, 2 cm Ampl.)
Particle Concentration, [/cm³]
Runtime, [s]
0
1
2
3
4
5
6
0
200
400
600
800
1000
1200
Sample #4
Sample #5
Sample #6
Sample #7
Sample #8
Sample #9

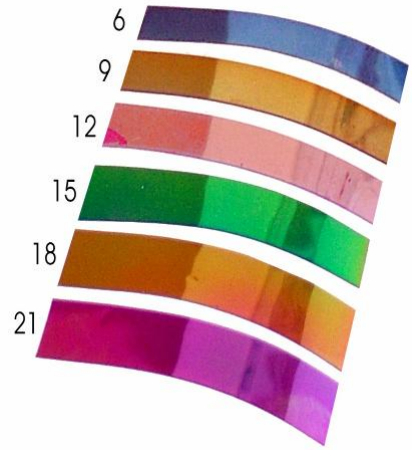
Particle size distribution



What are smart pigments?

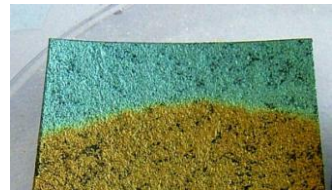
A novel technology to transform nano-structural changes into variable color

- Tunable color
- Applicable/printable on any surface
- Multi-color same-chemistry
- Stable versus bleaching
- Nano “material use” -> resources
- Smart metallic layout
- Less to non-toxic
- Machine readable
- Extreme thermal robustness
- Can be combined with barcode and labels



What are smart pigments?

- Novel colors for printing
- Indicators
- Anti-counterfeiting
- Corporate Identity
- Pharma packaging
- Intelligent packaging
- Cosmetics
- Design
- Jewellery
- Pigments for ….

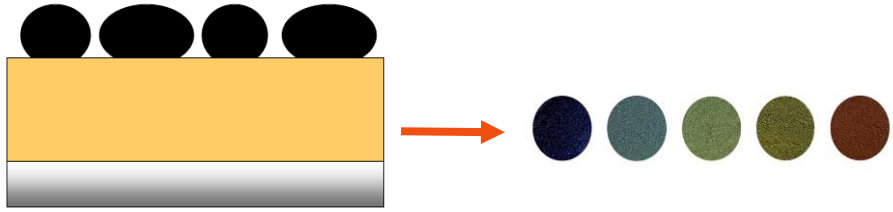


Structure of smart pigments

Smart pigments are based on REA (Resonance Enhanced Absorption) principle

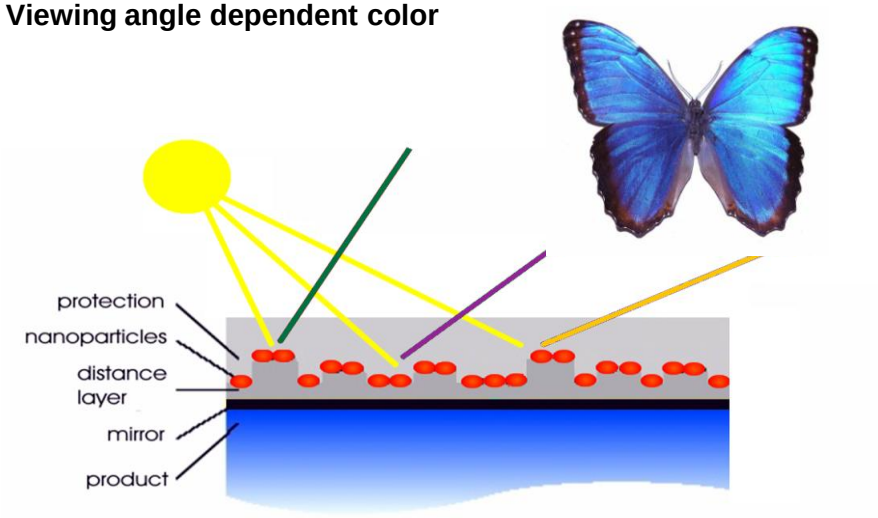
All REA systems consist of three layers:

- mirror bottom layer (e.g. metal or material with a high refractive index)
- middle layer (e.g. photo reactive polymer)
- nanoparticles on top of middle layer



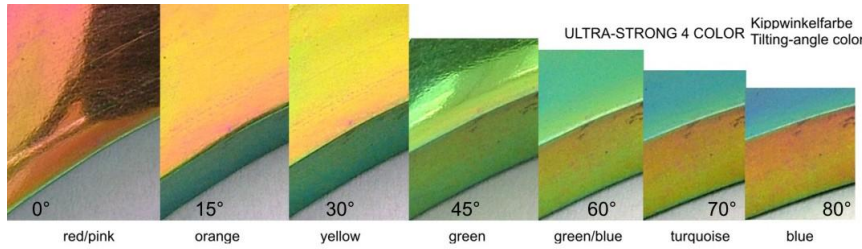
Structure of smart pigments

Viewing angle dependent color

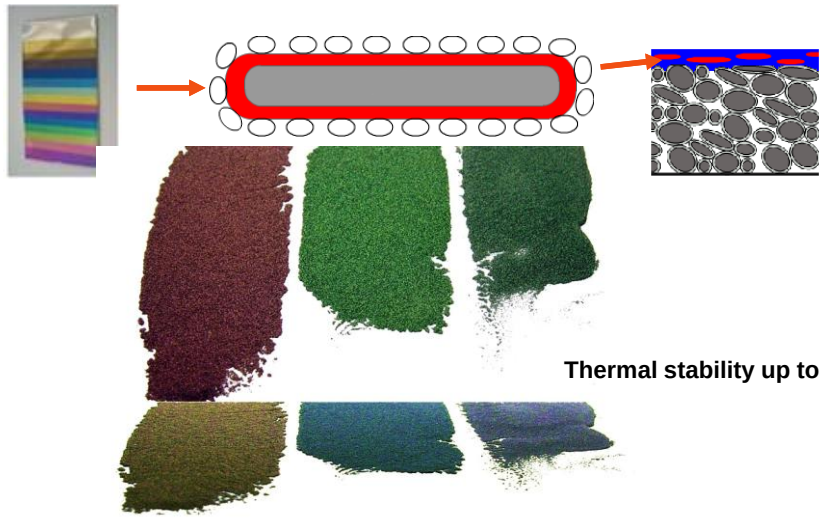


Structure of smart pigments

Viewing angle dependent color on on pressure-compacted aluminum

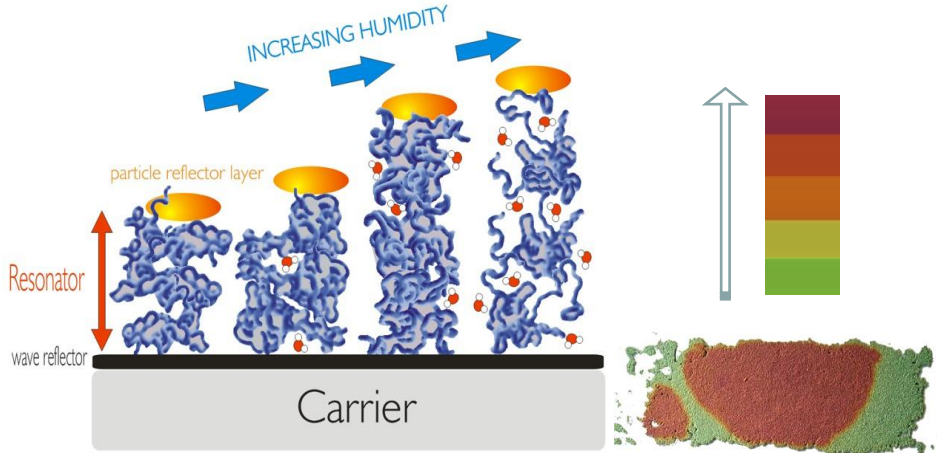


From smart layers to smart pigments



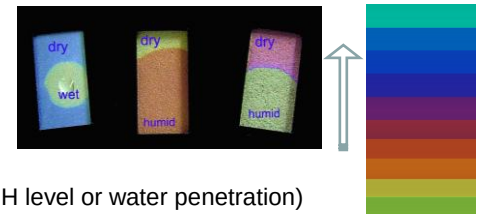
Thermal stability up to 600° C

Smart pigments for humidity indication



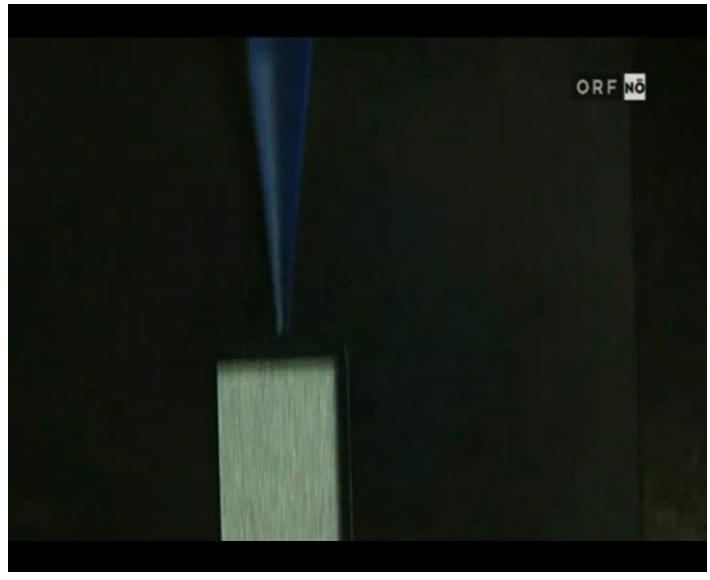
Smart pigments for humidity indication - SHIs

- SHIs can change color from
  - blue to green
  - from green via yellow to red
  - from red to green (indicating RH level or water penetration)



- High humidity coupled with poor packaging methods is causing most corrosion of metals as well as moisture damage to food products.
- An industry wide standard for packaging of semiconductors was released already in 1989. SHIs for the semiconductor industry indicate RH-levels of 5, 10 and 15 % and since JSTD-033B in 2005 require indication of 5, 10 and 60 %.

Video



Summary

- Nano-hybrid technology combines nano and micro
  - higher surface area
  - modification of surface properties
  - can be processed as easily as standard coating pigments
  - no health risks according to measurements with the NDT method
- NDT method allows for the analysis of the whole spectrum of dust particles from paper surfaces
  - excellent correlation with conventional methods
  - both technical aspects (dust emissions during the printing process) and health aspects (endangering by UFP) are determined
- Smart pigments exhibit a wide range of different colors which can be triggered by any chemical or physical stimulus
  - new printing technologies
  - indicators (packaging, pharmaceutical, medical, technical applications)
  - design (jewellery, surface finishing, etc.)

Acknowledgment & Disclaimer

Many thanks to

- AT&S PHOTONICS
- eco plus
- FFG

FORWARD - LOOKING STATEMENTS

It should be noted that certain statements herein which are not historical facts, including, without limitation those regarding expectations of market growth and developments; expectations of growth and profitability; and statements preceded by "believes", "expects", "anticipates", "foresees", "may" or similar expressions, are forward-looking statements. Since these statements are based on current knowledge, plans, estimates and projections, they involve risks and uncertainties which may cause actual results to materially differ from those expressed in such forward-looking statements. Various factors could cause actual future results, performance or events to differ materially from those described in these statements. Such factors include in particular but without any limitation: (1) operating factors such as continued success of manufacturing activities and the achievement of efficiencies therein, continued success of product development plans and targets, changes in the degree of protection created by Group's patents and other intellectual property rights, the availability of capital on acceptable terms; (2) industry conditions, such as strength of product demand, intensity of competition, prevailing and future global market prices for the Group's products and raw materials and the pricing pressures thereto, financial condition of the customers, suppliers and the competitors of the Group, potential introduction of competing products and technologies by competitors; and (3) general economic conditions, such as rates of economic growth in the Group's principal geographical markets or fluctuations of exchange rates and interest rates.

Mondi does not

a) assume any warranty or liability as to accuracy or completeness of the information provided herein
b) undertake to review or confirm analysts' expectations or estimates or to update any forward-looking statements to reflect events that occur or circumstances that arise after the date of making any forward-looking statements.