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berührungslos messen

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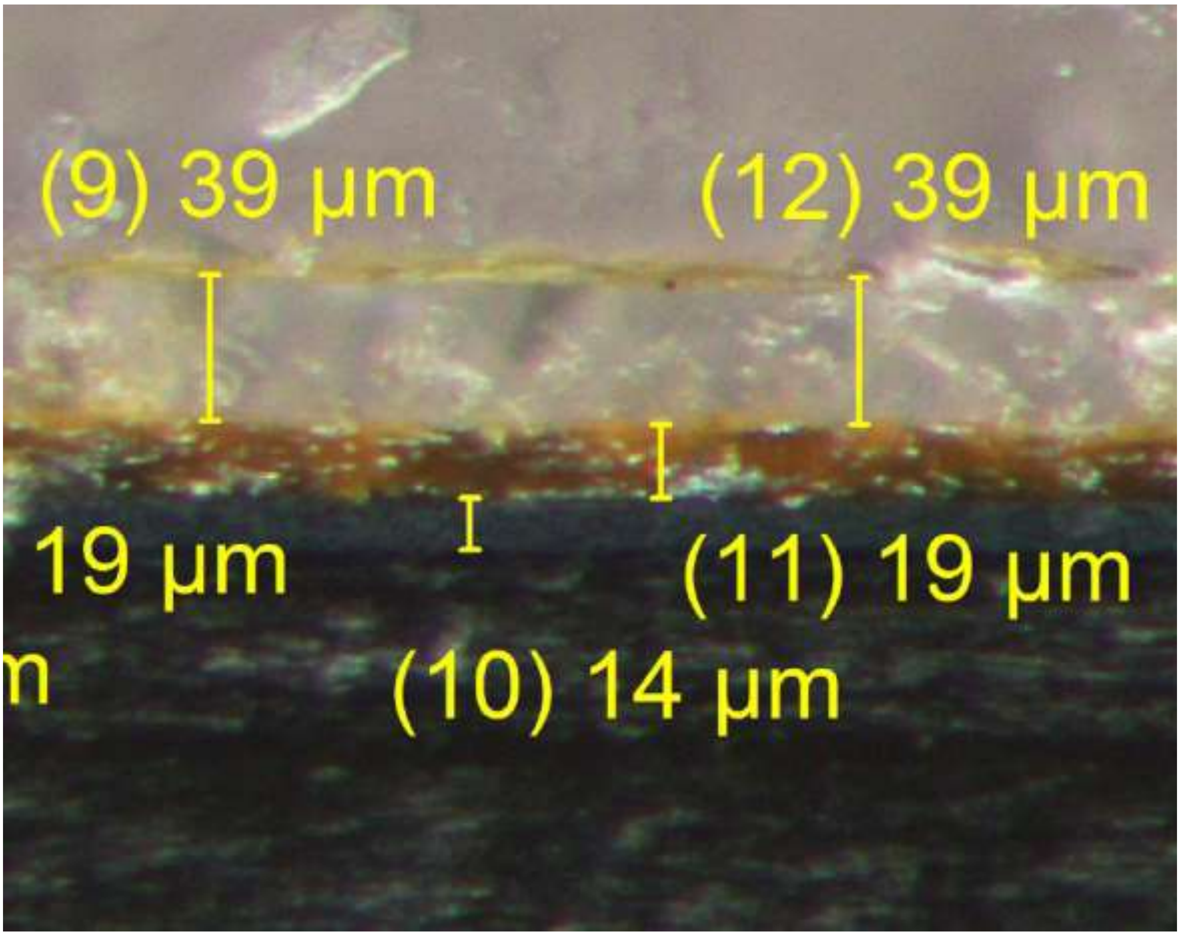
Non-destructive measurement of the thickness of a coating on plastics



Preface:

The use of plastics is growing in all industries, not just for decorative purposes. Parts made of plastics are lightweight, not susceptible to corrosion, they can be shaped as desired and structurally stable formed and can even be used directly after molding without mechanical processing. All these advantages make plastics, in addition to the low price, interesting also from the economically point of view. They replace components that used to be made of steel, such as door handles, shock absorbers, lights or trim strips, and much more. Despite all the good properties of the plastics, a weak focus is still the surface, which is sensitive to abrasion, weathering or to various chemicals. The surfaces can be damaged or scratched at the slightest touch and they lose their original shine after a short time, which is why plastics are coated with different paint systems.

We measure the thickness of:

- Abrasion and scratch resistant coatings
- chemically resistant coatings
- antistatic coatings
- coloring layers
- reflective coatings

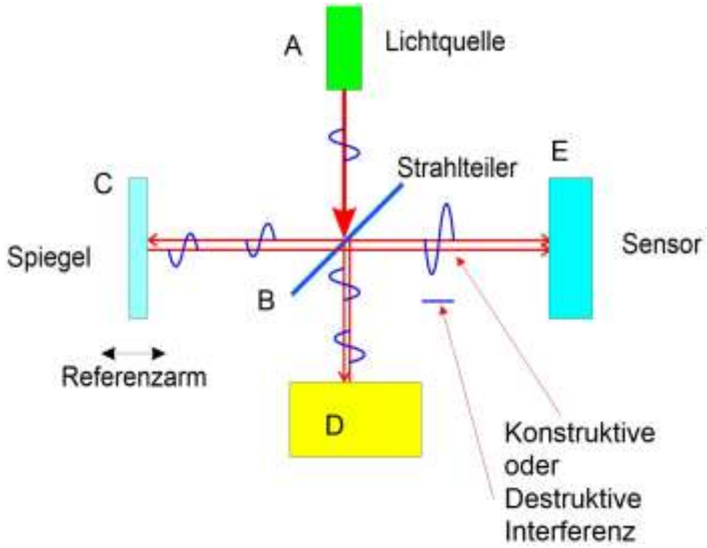
Table of coated car parts

		Farbe	Dicke in mü							
Schichtbezeichnung	Zusammen-setzung		von	bis		Partikel			Bindemittel, Einbettmasse	
Norm-Schichtaufbau	Primer	Grau	7	15	deckend	streuend		2K Polyurethan		
		weiss		20	deckend	streuend				
	Basislack	Alle Farben	10	40	deckend	streuend		Polyacrylat, Polyurethan	Melaminharz, Polyester	Evtl. Andere
	Klarlack	transmittiv	25	60	nicht deckend, keine Partikel	2K Polyurethan				
Metallic- Schicht	Primer	Grau	7	15	deckend	streuend		2K Polyurethan		
		weiss	bis	20	deckend	streuend				
	Basislack	Alle Farben	10	40	deckend	streuend	reflektierende plättchen-förmige Partikel	Polyacrylat, Polyurethan,	Melaminharz, Polyester	Evtl. Andere
	Klarlack	transmittiv	25	60	nicht deckend, keine Partikel					
Perleffekt- Schicht	Primer	Grau	7	15	deckend	streuend		2K Polyurethan		
		weiss								
	Basislack	weiss	10	20	deckend	streuend		Polyacrylat, Polyurethan	Melaminharz, Polyester	Evtl. Andere
	Perllack		5	10	semitransparent, streuend, reflektierend, interferierend	Plättchen-förmige Pigmente				
	Klarlack	transmittiv	25	60	nicht deckend, keine Partikel			2K Polyurethan		

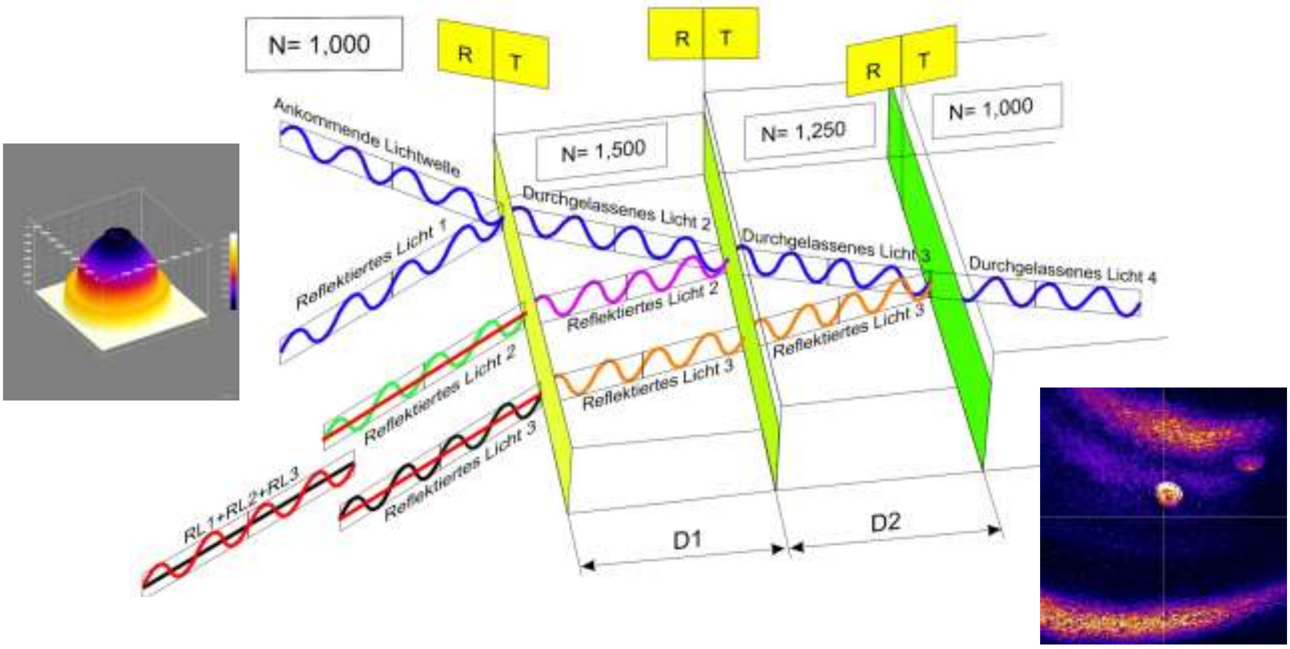
The table shows an overview of the coating systems that are measured today without contact and with the highest precision. If metallic layers are used or non-transparent coatings must be measured, our layer thickness measuring system is optimized with other physical sensors. With the help of the methods which are available today, it is possible to measure reliably all the coatings shown in the overview.

How does it works:

Our coating thickness measuring systems are based on a unique Michelson interferometer array. The interferometer allows to measure the time of flight of photons, from which ultimately a geometric size (path) can be deduced. In contrast to conventional interferometers, we work with an ASP array (Active Sensor Pixel Array) consisting of 300 * 300 pixels, where each pixel is equipped with its own lens and his own signal perprocessing, implemented directly on the chip level.



From the light source, a monochrome light front is emitted. The light front reaches the beam splitter, half of which is directed from a mirror, the other half to the object. At the mirror, the light wave is completely rotated by PI and reflected back to the beam splitter. The part of the light that reaches the object is reflected, absorbed and transmitted there. If we assume no absorption, it is sufficient to determine only the transmitted part of the light, because the reflected part is also rotated by PI.



In the graphic, R stands for reflection and T for transmission. N denotes the refractive index of the material and D denotes the layer thickness.

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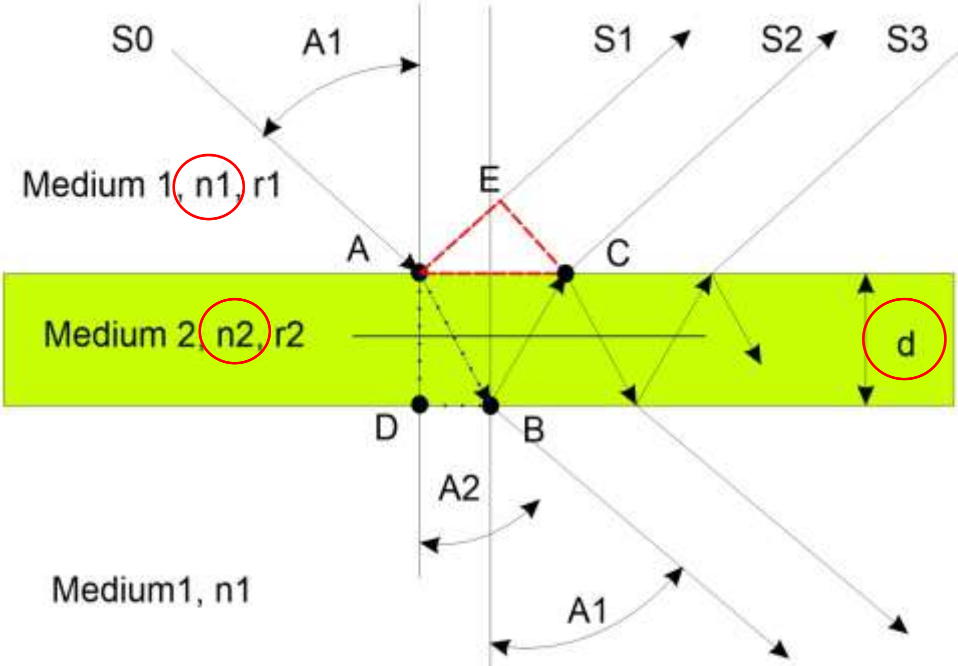
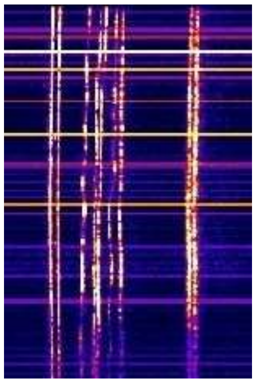
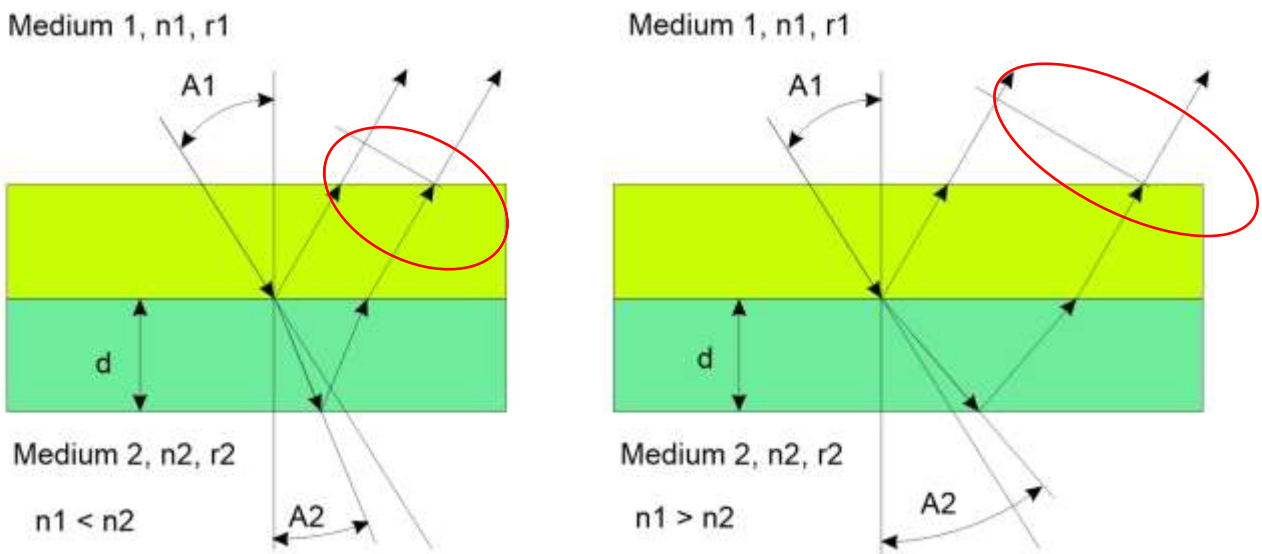
The emitted light wave is always retained in its frequency, but temporal differences arise as follows: ¨

- the light front, which is reflected by the mirror and the light front coming from the surface of the object, interfere with the beam splitter as a function of the object distance.
- The light front, which is reflected by a separation point between two layers, influences the light wave reflected from the object surface by the path difference. This leads to a change in the brightness of the interference pattern at the beam splitter and, in addition to the refractive index, includes the thickness of the layer.





In fact, it is relatively easy to detect the spatial position of the surface of an object and to measure the thicknesses of the individual layers from the path difference (graphic above, distance CE), provided the refractive indices are known. If the refractive indices are not known, two monochrome light sources are used to extract the desired layer thickness from the signals. The following graph shows the same layer thicknesses but unequal refractive indices. The gait difference is very clear.



The retardation is, in contrast to reflection, a periodically variable size and clearly a function of the thickness of a layer.

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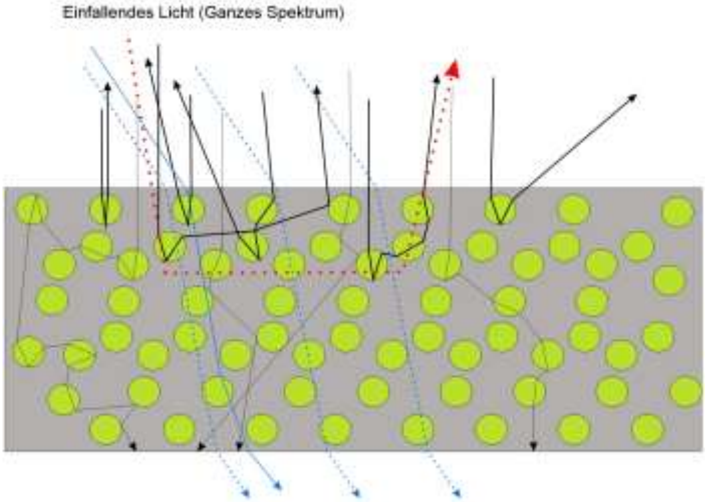
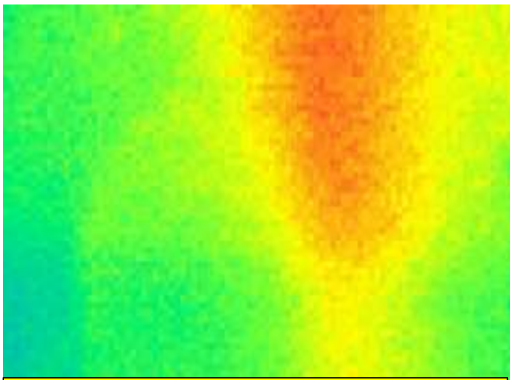
What if the layers glitter or scatter?

In the case of opaque or diffusing layers (bottom left diagram), oxides, pigments or other particles are often embedded in the layer, which prevent the light from penetrating. If the particles scatter, the object no longer produces a clear light front which can be reflected back to the beam splitter. Such layers can no longer be measured with short-wave light; longer-wave light is necessary. At the bottom right is the OCT image showing the thickness difference in a gas barrier layer of a coffee capsule.





LW_OCT Bild (Dickenmessung)

When using radar sensors in driver assistance systems, electrically active layers have an effect on the accuracy of the measured signal, which is why a homogeneous and defined layer thickness is of interest for vehicle coating.

This image is not available for third party staff.

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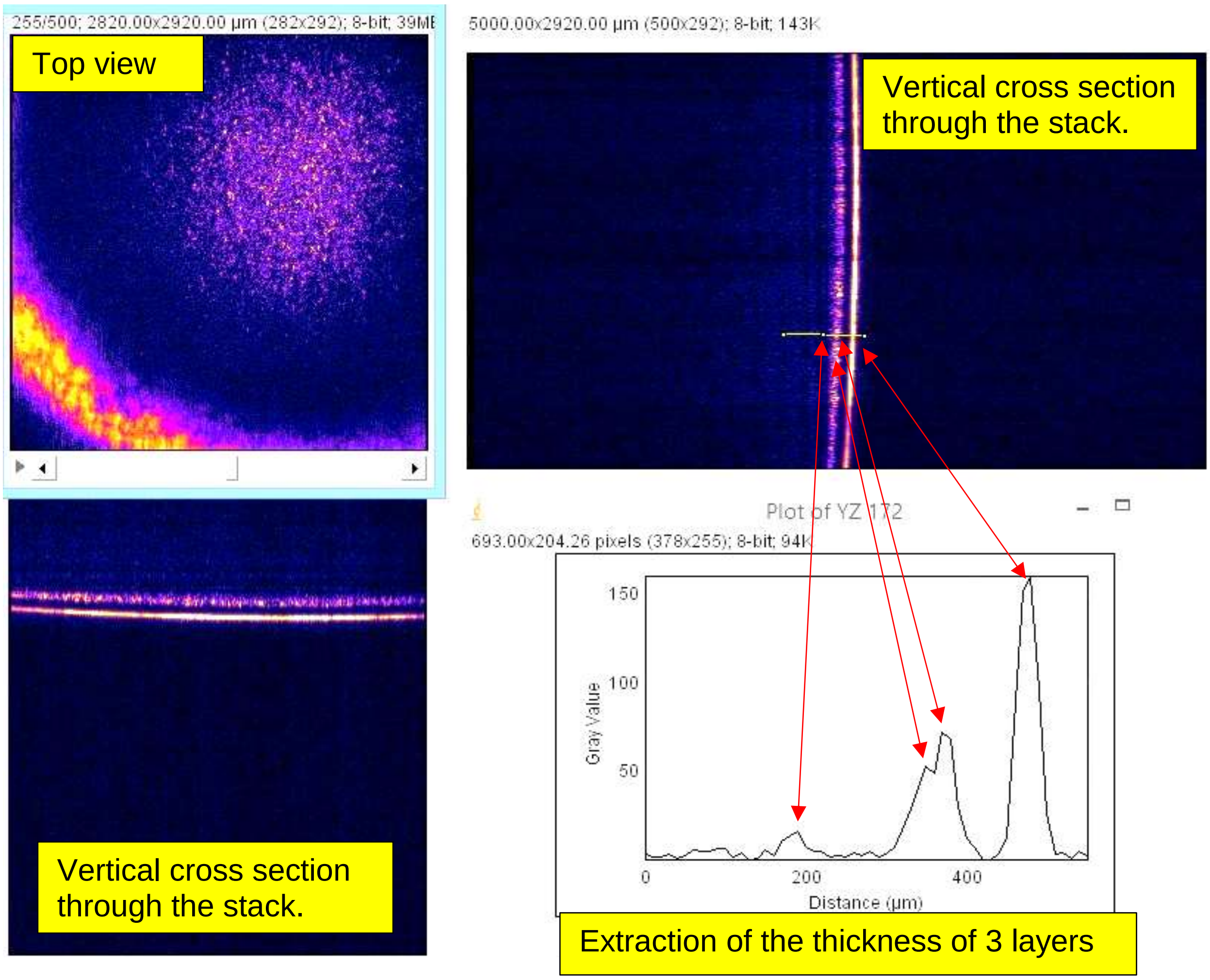
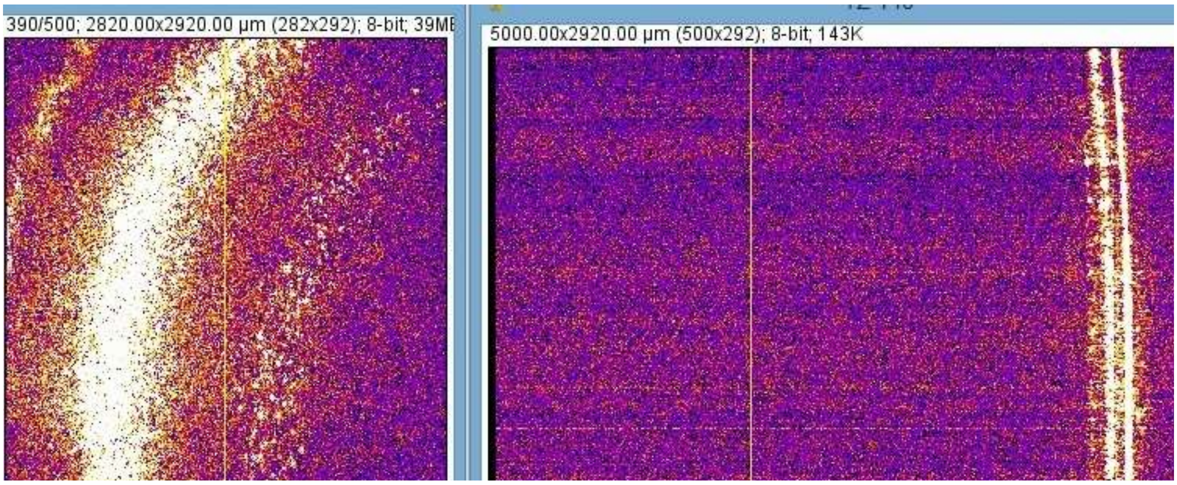
Example 1 Measuring the coating thickness of coated plastic parts



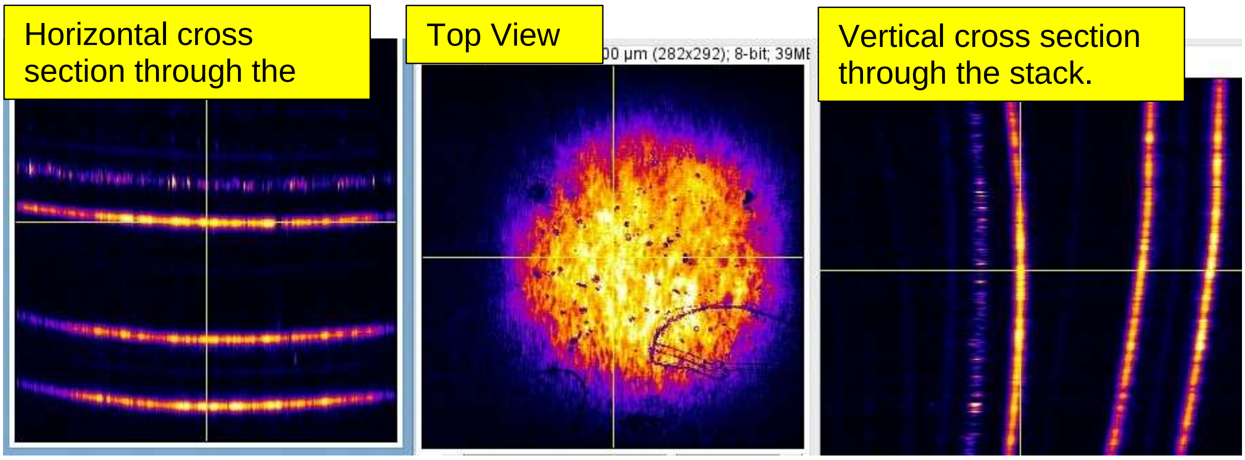
Example 2 OCT- OCT measurement of coated plastic parts

A layer of glitter makes light pass partially. With the ASP arrays, it is therefore also possible, with the desired spatial resolution, to measure the thicknesses of layer materials which are filled with beads or reflectors.

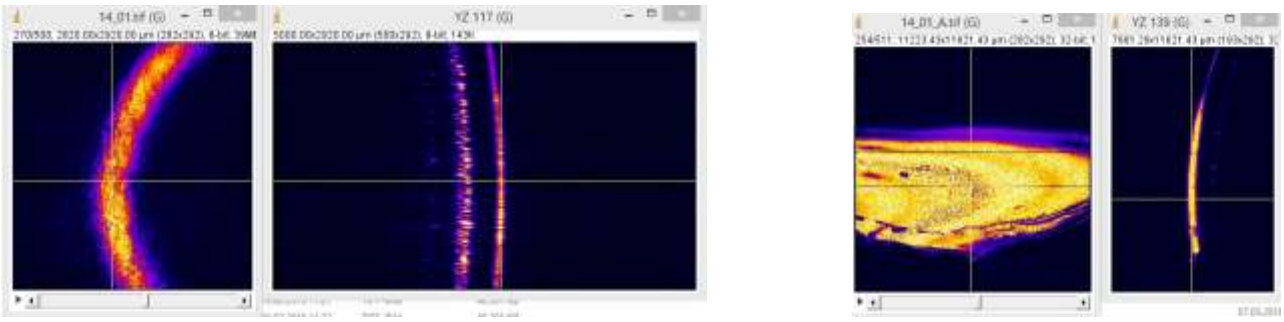


With a single light pulse, all interfaces between individual films or bearings of a coating appear because there is a difference in refractive index.

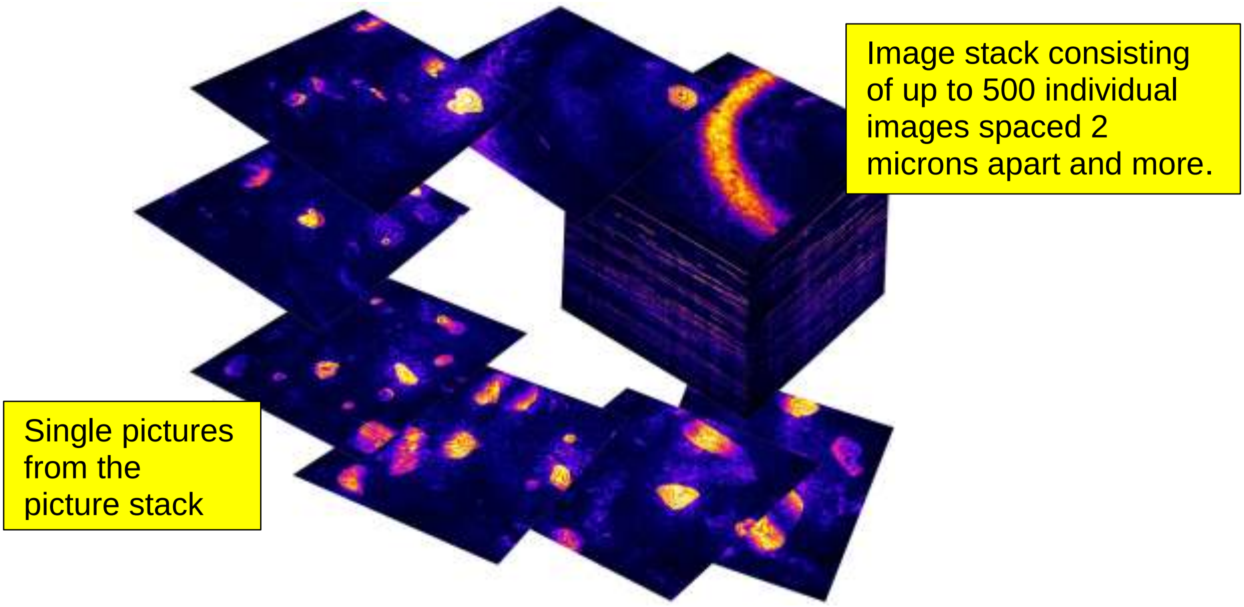
Example 3 OCT- measurement of coated plastic parts
The individual layers can be extracted from the OCT data with micrometer precision. The following picture series shows on the left the horizontal section through the picture stack of 500 pictures, in the middle the top view and to the right of it the vertical section.



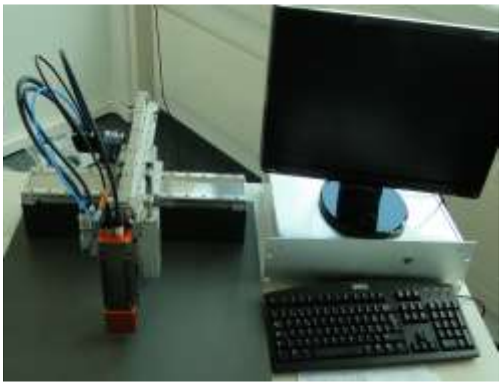
Example 4 OCT measurement of coated plastic parts
The following pictures show the top view and the vertical section of an OCT measurement on the same object with a light source of 850 nm (left) and 440 nm (right).

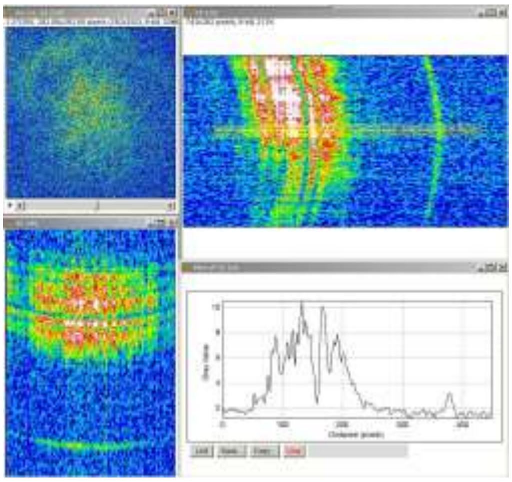


Each single image from the stack can be consulted for evaluation. The distance from image to image can be selected between <1 µm to higher than 1 mm. In the OCT method, the z-axis is decoupled from the lateral resolution, in contrast to conventional imaging or convocative methods.



Optical coherrence tomography → OCT- Measuring system





pOCT- Messkopf

Sensor	SI
CMOS Sensor	300*300 Pixel
Dynamic	1 Mio Images per second
NIR Sensitivity	yes
Dynamic range	up to 120 dB
Cameralink	GigE
Scaling	up to 12 bit
Image dynamic	up to 1 MIO fps
Compatibel with	Halcon, Labview, Matrox

OCT- Method

The method works without contact and with monochrome light as measuring tool.

Even today, the process is subject to harsh conditions in the industrial environment and fulfills daily tasks that could not previously be solved.

The process opens a new path in industrial production and is a key tool for modern industry.

We provide manufacturers and operators with optimized production support and state-of-the-art solutions to meet the growing demands of the marketplace. Do not hesitate to contact us and describe your application to our experts, so that we can advise you competently and purposefully. Our experience in non-contact measurement has grown steadily in more than 30 years.

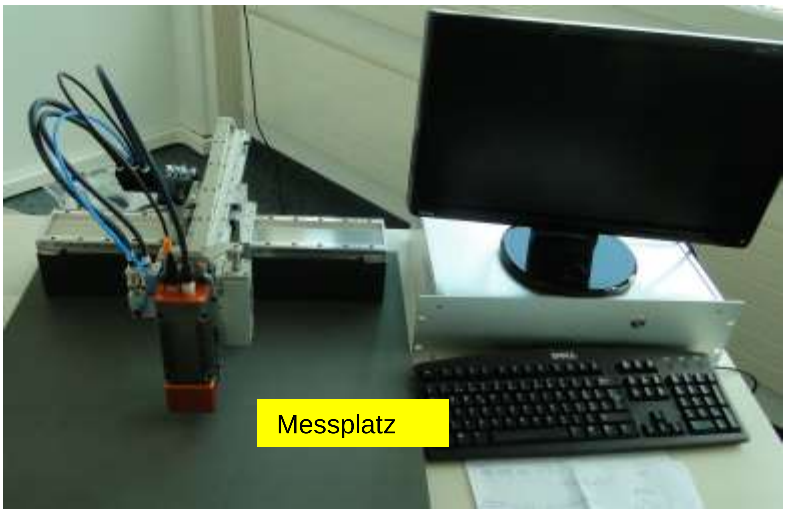
Good to know:

- We have the requested skills and equipment to solve a variety of tasks.
- In the sensor every pixel on the chip is equipped with a microlens ansl also with the signal preprocessing. The system captures 1 mfps (million frames per second), which opens up a new dimension in the OCT process.
- Depending on the task, the measuring distance can be several cm!
- The product can be moved or measured at standstill.
- The light source and the sensor are matched in their performance and frequency.
- Further optimizations (coherence length, scanning) can be performed with reasonable means in our laboratory with an optical design.

Measuring place fort he Laboratory:

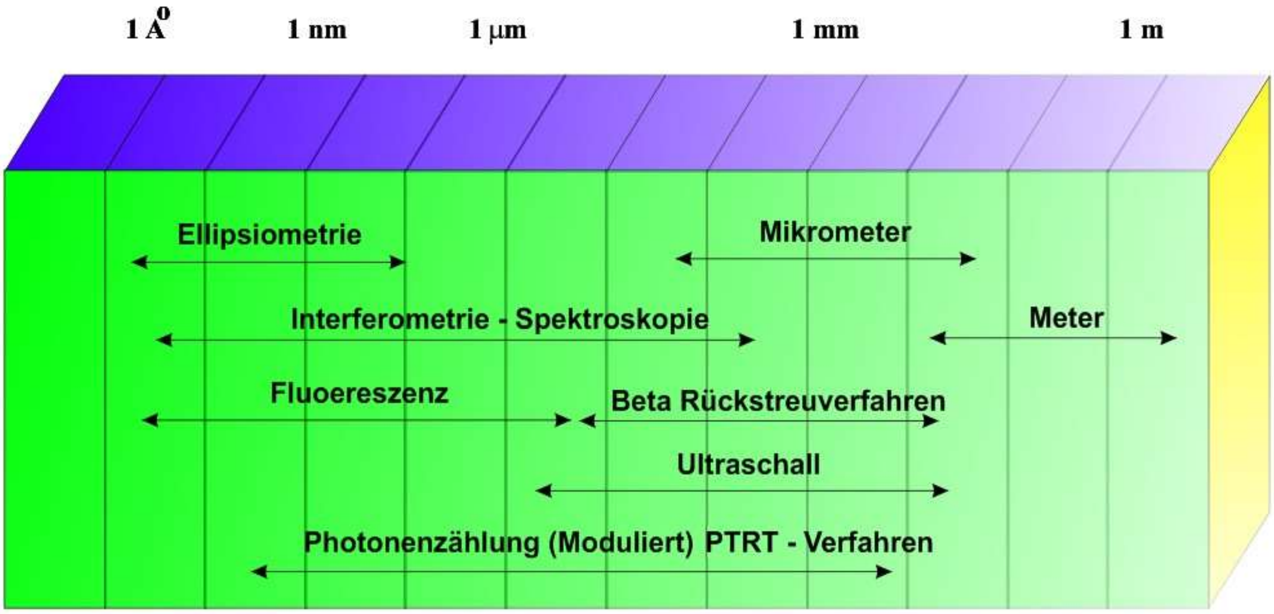
- The pulse source supplies the parallel optical light plane in the required power.
- The CMOS special camera captures the signals with the necessary dynamics and in the desired resolution.
- The laboratory system is available for process integration and test measurements.

- The expenses that accrue for the integration of the method are reasonably low, because the measuring concept has been tested as such and has proven itself in the industrial environment.



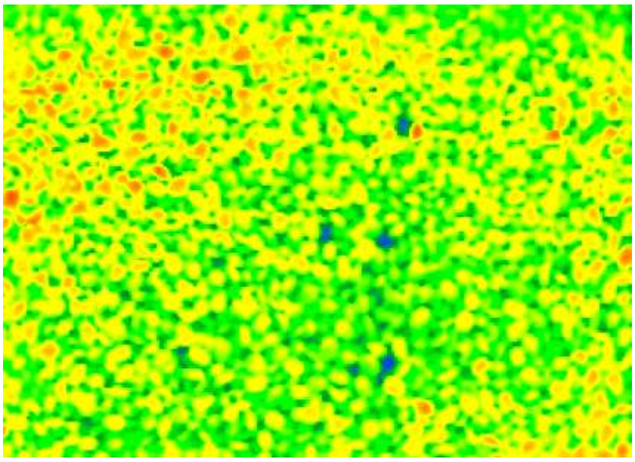
- • Exclusive versions for defined applications are possible, but require a new design of the measuring head and possibly of the sensor chip.

We measure from nanometers untill millimeters



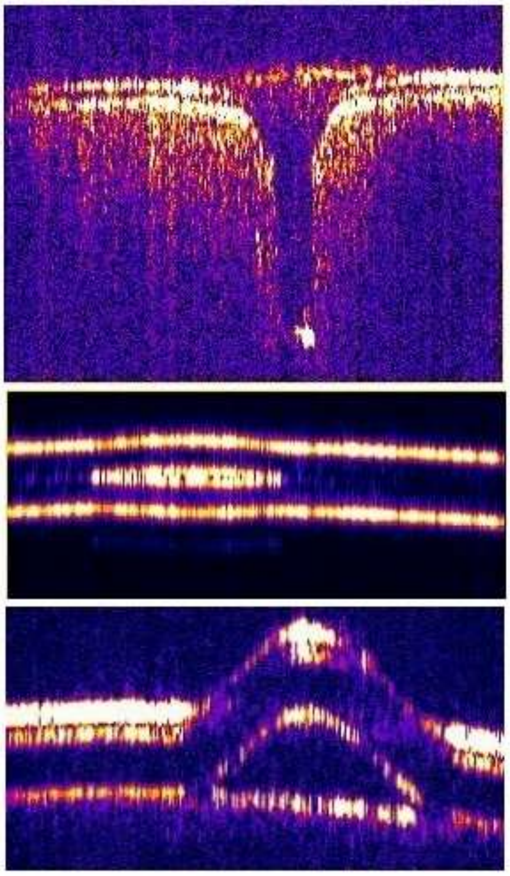
Overview of methods and methods for the measurement of all kinds of coating thickness.

Do you find the chocolate particles in the coffee beans or do you recognize a hair in a sealed seam?



Ask us - we'll show you how easy it is.

You can also use plants for our own test purposes. We offer expertise in photon measurement technology and experience with state-of-the-art technology. Incidentally, it is not important in the OCT process whether to search for control holes or measure layer thicknesses. The measuring device differs essentially only by the evaluation algorithms.



Picture above: Micro hole in a food bag.

Picture center: Delamination between two films.

Picture below: Seam defect. The upper film separates from the substrate.

- For packaging films (PET), defect sizes between 150 and 500 µm are detected over the entire surface.
- In the case of technical films, efforts are being made to reliably find defects of 50 to 200 µm in size.
- For surface protection films, error sizes from 60 µm to 160 µm are still relevant.
- For transparencies with defined properties, the sought error sizes are often between 25 µm to 100 µm.

For more information, see our description "Solutions from Experts" under www.flo-ir.ch

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