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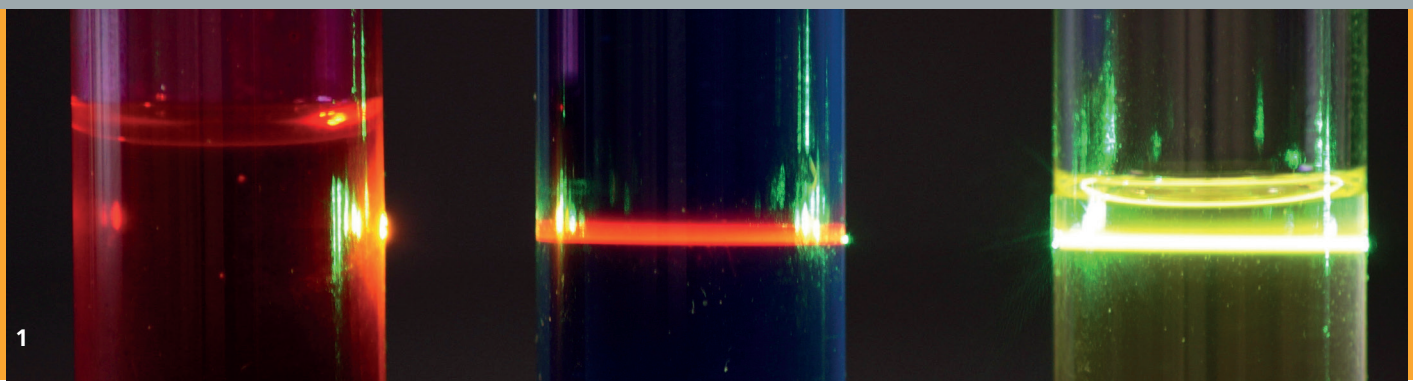

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PROCESS CONTROL FOR SILICONE COATINGS

IN-LINE IMAGING OF THICKNESS

1 *Dye solutions and a green laser demonstrate optical absorption (left), fluorescence (middle), and diffraction (right)*
2 *Thickness distribution of a lacquer coating on a PET film recorded on a running film*
3 *Silicone coating on paper at day light (contrast enhanced)*
4 *Silicone coating on paper, fluorescence light*

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pioneers in polymers

The challenge

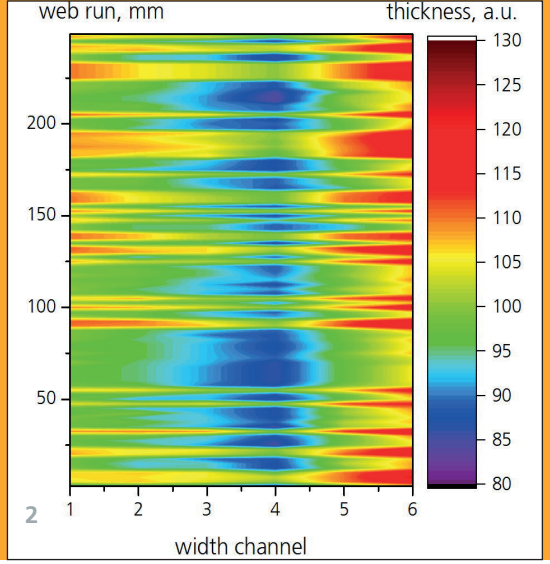
Measuring the thickness distribution of thin transparent coatings on transparent materials is a challenge, especially as an in-line process control technique. The challenge becomes greater the thinner the layers or the more similar the refractive indices are. This challenge arises, for example, with submicron lacquer coatings on polymer films or impregnations such as siliconization.

The solution

Fluorescent dyes in a very small concentration can be added to transparent coatings in order to enable the in-line measurement of the thickness distribution. The dyes are not visible by the naked eye and they do not influence the transparency nor other properties of the coating as mechanical strength.

The project

The technology was demonstrated with an improvised measuring system. The objective of this project is to bring the technology to pilot level and to determine the parameters for an industrial measuring system.



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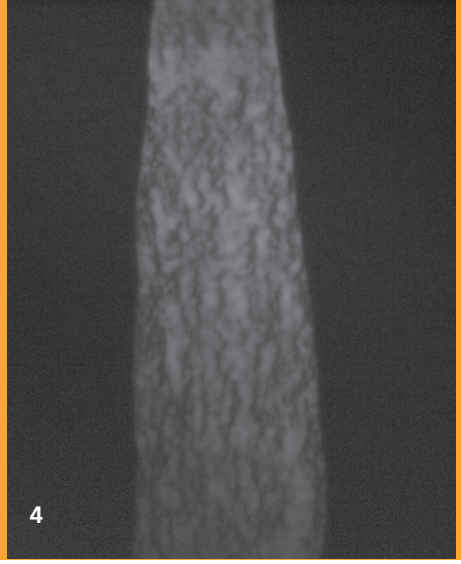
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Fluorescence imaging

Fluorescence means that the dye can absorb light of a particular wavelength (colour) and emit light with a longer wavelength (other colour). It can be measured with an extremely high sensitivity and, therefore, only a very small concentration (parts per million) of a dye is sufficient for its detection in a thin coating. Such a small concentration in a thin layer is not visible to the naked eye and it does not affect the properties of the coating material like its mechanical strength, modulus etc. Since the dye is dispersed in the coating on a molecular level, the fluorescence intensity is proportional to the thickness of the coating.
The distribution of the fluorescence intensity of a dye dissolved in a layer can be recorded on a running web. The fluorescence intensity represents the thickness at each point. These data can be recorded and processed for the detection of the thickness distribution and defects.

The work plan

The following work is planned:

- selecting silicone resins and appropriate dyes
- formulation of dyes and silicone resins
- optical characterization of the resins with the dye
- preparation of silicone coatings
- supply of new silicone formulations to partners for test coating preparation
- set-up of prototype measurement system
- installation and test of prototype measurement system in Fraunhofer converting equipment
- determination of measurement parameters for pilot system
- deduction of parameters for industrial measurement system

Start: January 2020
Duration: 1 year
Costs: 9 000 € (min. 8 participants)

Benefits

The 100 % monitoring of a coating homogeneity can give rise to a new level of process stability and quality assurance. Beyond the monitoring, the data can be used to control the actual coating process and to make it more precise. The coating thickness can be adjusted to the lowest possible level to assure the intended effect.

The return on investment can be very direct. For example, if the thickness of a silicone coating can be reduced from 0.8 µm to 0.7 µm due to the reliable process control, the costs for the coating material are reduced by 12 %. This also reduces the energy consumption of the drying process.
By participating in the project the partners will have additional benefits:

- influence on project detail planning (materials, parameters etc.)
- first-hand information about results including a report
- workshop for up to two participants about technology, equipment, and project results
- exchange of experiences
- fast industrialization of the technology based on project results
- 1 year limited exclusivity

Future opportunities

The measurement of the distribution of coating thicknesses and thin layers provides relative values in the simplest case. The development of calibration procedures will allow measuring absolute thicknesses.

Fraunhofer POLO®

Fraunhofer is Europe's largest applied research organization and maintains 72 institutes all over Germany as well as a number of branches and offices in Europe and worldwide. The Fraunhofer-Alliance Polymer Surfaces POLO® combines the expertise of five institutes in the field of surface technology.