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Weathering-resistant functional films for outdoor applications

At SVC 2015 (25-30 April 2015, Santa Clara/USA, booth 1420), Fraunhofer FEP is presenting the barrier and transmission results of films that were exposed to all weather conditions for a year outdoors. The results are encouraging.

Flexible electronic components (e.g. thin film solar cells or bendable light sources and displays based on organic light-emitting diodes (OLEDs)) are opening up entirely new fields of application and design possibilities: flexible solar cells and diodes can be integrated into purses and clothing; bendable screens for mobile phones or curved televisions become possible; lightweight solar cells can convert light into energy on large areas of building facades or roofs of large industrial halls.

However, flexible elements must be well protected against environmental influences such as UV radiation and corrosive gases. They are encapsulated with glass or a coated film in order to remain functional. Scientists at Fraunhofer FEP are working on surface treatment and coating of plastic films in order to achieve the required encapsulation properties. Very low water vapour and oxygen permeability as well as protection against UV light with simultaneously very high transparency for visible light have to be achieved. In addition, the encapsulation has to be resistant against scratches and other mechanical stresses.

Past research results in the field of encapsulation were focused on interior applications and temporary outdoor use, where the elements were not permanently exposed to wind and weather. Fraunhofer FEP in cooperation with the partner institutes Fraunhofer ISC Würzburg and Fraunhofer IVV Freising has now succeeded in developing encapsulation on the basis of weathering-resistant fluoropolymers. An ETFE film – a material used for example for the facade of the Allianz Arena in Munich – was upgraded with what is known as a permeation barrier layer system to accomplish this. Dr. John Fahlteich, Project Manager for the coating of flexible substrates at Fraunhofer FEP, will present the results of the Flex25 research project funded by the Federal Ministry of Education and Research (FKZ 03V0224) at the SVC conference and introduce weathering-resistant encapsulation systems on ETFE film with water vapour permeation in the high barrier range as well as integrated UV protection.

Not only the protective effect but also light transmission through the film and the related efficiency of the encapsulated elements must be taken into account in the development of weathering-resistant functional films for outdoor applications. This is the development where FEP was able to make significant progress with a process for the optical antireflection coating of surfaces. The process is based on plasma-supported

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nanostructuring of large surfaces which can be realised at low cost with roll-to-roll processing and is therefore also suited for extremely cost-sensitive photovoltaic applications. Transmission values of 96.3% were achieved on ETFE with antireflection coating on one side, and 98.7% with antireflection coating on both sides. A favourable side effect: the nanostructures also help reduce the accumulation of surface dirt. Current results for studies of nanostructured films and their outdoor applications will be presented by Cindy Steiner at SVC.

Through this work, Fraunhofer FEP is able to offer its customers tailor-made processes and systems for coating of weathering-resistant films, for example for use in flexible displays, functional lightweight construction roofs or tents or to develop these products in cooperation with them. "Perhaps the work that will be presented will one day help to produce electricity with the facade of the Allianz Arena in Munich or the roof of Gondwanaland at the Leipzig zoo," says Dr. John Fahlteich, looking into the future.

Based on her successful work in the field of fluoropolymer nanostructuring, Cindy Steiner is supported by the Society of Vacuum Coaters (SVC) as a "Sponsored Student".

The visitors of the SVC 2015 can inform themselves about the latest developments in the field of vacuum coatings at Fraunhofer FEP by attending the following presentations:

Dr. John Fahlteich:

Ultra-High Multi-Layer Barriers on Weathering Stable Substrates for Outdoor Application

Session: "WebTech Roll-to-Roll Coatings for High-End Applications"

Thursday, 30 April 2015, 10 a.m.

Cindy Steiner:

Nanostructuring of ethylene tetrafluoroethylene films by a low pressure plasma treatment process

Session: "WebTech Roll-to-Roll Coatings for High-End Applications"

Thursday, 30 April 2015, 2:20 p.m.

Dr. Jens-Peter Heinß:

Substrate Cooling and Tempering during High-Rate-Vacuum Coating

Session: "Large Area Coatings"

Monday, 27 April 2015, 3:30 p.m.

Stephan Barth:

Adjustment of Plasma Properties in Magnetron Sputtering by Pulsed Powering in Mixed Unipolar and Bipolar Mode

Session: "High Power Impulse Magnetron Sputtering (HIPIMS)"

Monday, 27 April 2015, 3:20 p.m.

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Tim Weichsel:

Novel Magnetron Sputtering ECR Ion Source – An Emerging Tool for the Production of High Current Metal Ion Beams and Large Area Surface Processing

Session: "Plasma Processing"

Wednesday, 29 April 2015, 9:20 a.m.

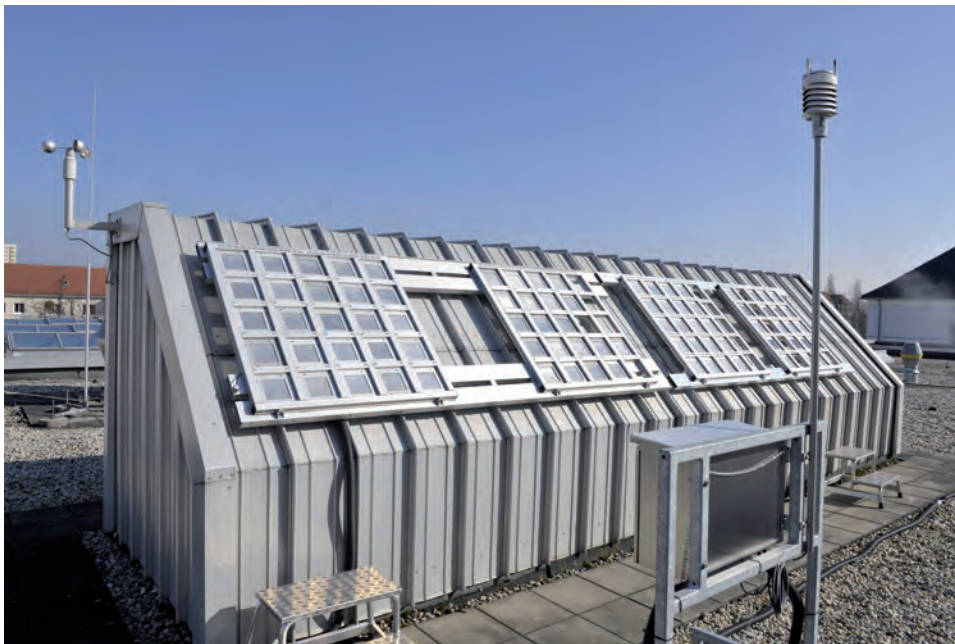
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Dr. John Fahlteich:

Tutorial Course C-336: "Transparent Gas Permeation Barriers on flexible Substrate"

Sunday, 26 April 2015, 8:30 a.m. – 4.30 p.m.



Weathering-resistant functional films

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The **Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP** works on innovative solutions in the fields of vacuum coating, surface treatment as well as organic semiconductors. The core competences electron beam technology, sputtering and plasma-activated deposition, high-rate PECVD as well as technologies for the organic electronics and IC/system design provide a basis for these activities. Thus, Fraunhofer FEP offers a wide range of possibilities for research, development and pilot production, especially for the processing, sterilization, structuring and refining of surfaces as well as OLED microdisplays, organic and inorganic sensors, optical filters and flexible OLED lighting. Our aim is to seize the innovation potential of the electron beam, plasma technology and organic electronics for new production processes and devices and to make it available for our customers. COMEDD (Center for Organics, Materials and Electronic Devices Dresden) with all known activities in organic electronics is now acting as a new business unit at Fraunhofer FEP, Dresden, Germany.