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## New process for application-specific anti-reflective coatings

**The Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP, leading research institute for the development of surface technologies and organic electronics, is presenting the latest results in anti-reflective coatings at ICCG 2016 in Braunschweig, Germany from June 13-16, 2016 at booth B2.**

Whether eyewear, windshields, display windows or solar cells – nearly everyone uses products that reduce reflections without being aware of it. These kinds of anti-reflective coatings provide on one hand crystal-clear viewing and on the other are able to capture nearly all the sunlight falling on solar cells coated this way, since there is practically no reflection on the surface.

These coatings, while hardly visible to users, offer a different kind of challenge to scientists when applied to various substrates like plastic films and rigid or flexible glass. The main focus when coating the substrate is to develop a coating process that is economical and can match the properties of the layers to the purpose of the specific application.

The researchers at Fraunhofer FEP have now tested a novel technology for creating anti-reflective coatings on glass. In a first step a gradient layer consisting of silicon dioxide (SiO<sub>2</sub>) and an additional supplementary component are deposited by means of a co-sputtering process. In a following process step the supplementary component is removed by an etching process. The result is a remnant layer of rough silicon dioxide. Thanks to the resultant continuous transition in optical properties from air to glass, anti-reflective behavior is exhibited by the surface of the glass.

A similar effect is offered by Fraunhofer FEP through its POLAR process for making plastic sheets or web anti-reflective. This process was originally developed jointly with Fraunhofer IOF and industrial partners. It nanoetches the surface of polymers directly by means of a plasma. The gradual transition in refractive index from air to polymer achieved this way is likewise anti-reflective.

In a conventional anti-reflective coating, layers of high and low refractive index are deposited alternately. The disadvantage of this approach is the restricted wavelength range that its anti-reflective effect is confined to. The width of the range can only be broadened by use of a complex system of interfering layers. In contrast, anti-reflective coating systems based on effects caused by rough surfaces have no sharply defined

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wavelength restriction to their anti-reflective properties. This allows the prevention of reflection over a wide spectral range by coating with a single layer or a single plasma etching step, respectively. The color of the layers is also quite neutral.

“The layers achieved with the new process are characterized by a good mechanical durability and the reduction of reflections over a wide spectral range,” explains Thomas Preußner, researcher for large-area in-line processing at Fraunhofer FEP.

Anti-reflective coatings are only one application example for the described novel co-sputtered method. The technology has demonstrated the feasibility for producing rough layers thus having the possibility to be applied in additional kinds of applications. It offers the potential of making battery and solar-cell electrodes larger and more effective through the use of rough layers, for example.

The comprehensive scientific know-how and proto-industrial facilities at Fraunhofer FEP enable specialized anti-reflective coatings to be developed in cooperation with clients matching their specific applications.

## Fraunhofer FEP at ICCG 2016

### Talks

#### Tuesday, June 14

Session 4 – Processes for Flexible Substrates

14:50 – 15:10, Invited Lecture

*The Road from S2S to R2R - Status, Risks and Visions for Processing Ultra-Thin Glass*

Dr. Manuela Junghähnel

Session 4 – Processes for Flexible Substrates

16:30 – 16:50

*Roll-to-Roll Deposition of Silicon Nitride Permeation Barrier Coatings Using Rotatable Magnetrons*

Dr. Matthias Fahland

#### Wednesday, June 15

Session 7 – Optics, Consumer Electronics, and Communication

15:50 – 16:10

*Towards Tunable Thin-Film Filters with the Use of Liquid Crystals*

Dr. Hagen Bartzsch

### Posters

P1.01

*Coatings with large surface roughness prepared by a co-sputtering method using dual rotatable magnetrons*

Authors: T. Preußner, M. Junghähnel, U. Hartung, T. Kopte

Fraunhofer FEP, Germany

P4.01

*Characterization of stochastic nanostructures on ethylene tetrafluoroethylene films*

Authors: C. Steiner, J. Fahlteich

Fraunhofer FEP, Germany

P4.03

*Influence of thin-film properties on the reliability of ultra-thin glass*Authors: J. Westphalen<sup>1,2</sup>, M. Junghähnel<sup>2</sup>, S. Weller<sup>2</sup>, G. Lorenz<sup>3</sup>, F. Naumann<sup>3</sup><sup>1</sup> TU Ilmenau, Department of Inorganic-Nonmetallic Materials, Ilmenau, Germany<sup>2</sup> Fraunhofer FEP, Germany<sup>3</sup> Fraunhofer IMWS, Center for Applied Microstructure Diagnostics (CAM), Germany

P4.04

*Processing of thin-films on ultra-thin flexible glass*

Authors: M. Junghähnel, M. Fahland, C. May, S. Mogck

Fraunhofer FEP, Germany

P4.05

*OLED lighting using ultra-thin flexible glass (G-Leaf™)*Authors: Stefan Mogck<sup>1</sup>, Michael Stanel<sup>1</sup>, Yoshinori Hasegawa<sup>2</sup>, Kaoru Mitsugi<sup>2</sup>, YukiUno<sup>2</sup><sup>1</sup> Fraunhofer FEP, Dresden, Germany<sup>2</sup> Nippon Electric Glass Co., Ltd., Japan**Visit us as well at our trade fair booth – B2!****Glass with anti-reflective coating**

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Picture in printable resolution: [www.fep.fraunhofer.de/press](http://www.fep.fraunhofer.de/press)

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.