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PECVD COATINGS FOR OPTICAL COATING SYSTEMS

Optical coating systems, for example anti-reflection coatings, optical filters or laser mirrors are usually produced by physical vapour deposition (PVD) methods such as evaporation or sputter deposition. Optical metal oxide coatings of a very high quality and hardness can be created by these methods. However, hard coatings are not always what are suitable on soft substrates such as plastics. Deformations can give rise to mechanical stresses and cracking in the coatings and thus have a negative effect on their optical properties. A chemical vapour deposition process has now been developed at the Fraunhofer IST which allows the mechanical properties of coatings to be varied over a wide range. This in turn means that optical coating systems can be better adapted to plastic substrates.

Testing a new PECVD source

To obtain a better understanding of the interplay of soft organic and hard oxidic coatings in optical coating systems an innovative PECVD source has been integrated into a conventional turntable sputtering chamber for optical coating systems (see Fig. 1). It is characterized by a low amount of energy being supplied to the substrate during the coating process, what has advantages for the coating of plastic substrates. The objective of the activities at the Fraunhofer IST was to integrate and also to optimize the source with regard to the highest and most homogeneous coating rate possible, a low input of energy to the substrate and variable mechanical coating properties.

Homogeneous coatings with a high optical quality

In comprehensive testing of the source using hexamethyldisiloxane (HMDSO) as precursor and by running various simulation calculations, the coating rate, the energy input, the coating properties and the coating homogeneity of the source were optimized. The simulation calculations in particular proved very helpful here in remedying design weaknesses in the source (anodic hotspots). In addition, iterative improvement of the masks also made it possible to achieve considerable improvements in the homogeneity of the coatings. Furthermore, experiments confirmed that the mechanical properties of the coatings (elongation at break) can be varied by the source (see graphs on the opposite).

Outlook

It is now possible with the aid of the modified deposition setup to integrate organically modified layers in the ceramic stack. This permits the creation of gradient coatings, for example, in which the mechanical properties of the coating are adapted to those of the substrate. In addition, outstanding barrier effects against the diffusion of water or oxygen can even be obtained by combinations of organic and inorganic layers.

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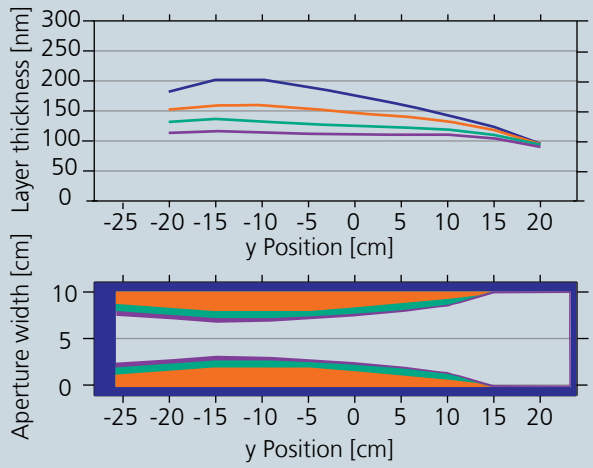
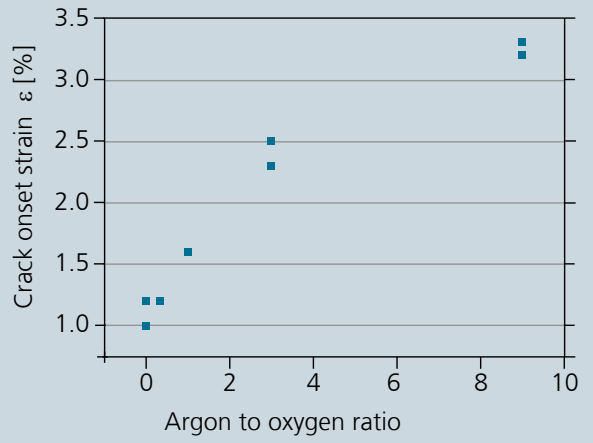
Influence of masks on coating homogeneity.



Elongation at break as a function of process gas composition.



1 *Turntable sputtering system with integrated PECVD source.*

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