OR0104

Realization of advanced multi-index-designs by magnetron sputtering

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Binary dielectric coatings consisting of high and low index material layers can fulfil a wide range of optical requirements. Practically all normal incidence spectral specifications with incident medium air can be realized. Yet many applications require oblique incidence. Thereby polarization effects occur since the effective optical indices for both polarization states are different. For cemented systems polarization splitting is further amplified. As a rule binary designs of two refractive indices only lead to very complex layer systems or the specifications cannot be matched at all. Additional degrees of freedom in terms of additional materials with intermediate refractive indices can significantly reduce design complexity or even enable realization in the first place.
Two coating materials at a time are available on the Leybold HELIOS sputtering system. Layers with intermediate refractive indices can be realized by mixing these two materials during deposition using co-sputtering. A process for mixed layers with high optical quality and good mechanical properties (e.g. layer stress) has been developed and experimentally verified. The resulting refractive index can be adjusted over the entire range between low and high index material.
Using three or more refractive indices a thin film system can be designed to match the resulting effective index of the layer system to the given boundary conditions (glass refractive index, angle of incidence range) for both polarization states. In case of sufficient small refractive index increments even quasi-gradient-systems can be realized.
The latest technology development results are summarized in this presentation.

Keywords
Magnetron sputtering
Optical coatings
Multilayer films
Gradient coatings
Index engineering