MATERION

COATING MATERIAL NEWS

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UV COATING TECHNOLOGY: MATERIALS & PROCESSES

Optical coatings that perform in the ultra violet (UV) at wavelengths shorter than ~350 nm require materials with low absorption. Fluoride compounds are exclusively required for wavelength shorter than ~200 nm, labeled the Deep UV (DUV) region. This paper outlines the application of fluoride compounds to satisfy special coating requirements in the DUV spectral region, and the materials and processes involved for manufacturing and depositing these critical materials.

UV is divided into three regions. "UVA" is the Near-UV consisting of wavelengths 400 – 320 nm; "UVB" is between 320 and 280 nm; and "UVC" from 280 nm to 200 nm, shortward of which is the DUV region.

Metal oxide compounds that are used in visible through shortwave IR applications are not suitable for high performance UV optical coatings because they possess absorption at UV wavelengths - with a few exceptions. The exceptions are the low-and medium refractive index oxides SiO_2 and Al_2O_3 that can be used to ~200 nm. The high-index HfO_2 is useable to ~225 nm. These oxide materials have alternate chemistry, or a limited number of stable sub-stoichiometric states, or high oxygen mobility which opens the door for some custom-coating materials. When manufacturing fused silica, the chemical route to the principle oxide is essentially eliminated and the result is a glass that can be further refined into high quality substrates as well as coating materials critical for UV and NIR intense photonics. This glass will also have the bonus of being without detrimental grain boundaries, trapped gases and pocket instability.

In the case of Al_2O_3, a slightly sub-stoichiometric state is desirable. Unlike other oxides that lose much oxygen upon evaporation, aluminum oxide by its nature is content to share localized oxygen atoms and densify into a very useful melted plug. This property is advantageous in depositing the oxidized thinner ¼ wave layers in the UV region. Considering the high-index UV candidates, HfO_2, while expensive due to its nuclear industry extraction genesis, has an extraordinary oxygen mobility which can be harnessed to deposit durable dielectric layers that transmit from the UV to the SWIR. In addition, contrary to its periodic table partner ZrO_2, there are no catastrophic phase changes and an increasing number of reactive processes ranging from the full oxide to the pure metal.

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