An Approach to Increase the Stability and Durability of Deposited Zinc Sulfide (ZnS) Layers.

A world-renowned European R & D organization sought Denton Vacuum's help in accelerating their wafer-level IR filter development program by employing multiple evaporation sources and an ion source for ion assisted deposition (IAD).

There exists a dramatic need to increase the stability and durability of deposited zinc sulfide (ZnS) layers. Ion Assisted Deposition (IAD) for the production of high performance optical coatings can provide stable and durable thin films for a wide variety of stringent spectral specifications from the UV to the Far IR. IR filters, a key element of the camera sensor technology in smart phones, digital cameras, automotive back-up cameras and many other consumer and industrial products, remain critical to today's electronics.

Denton Vacuum and others have demonstrated that bombardment of a growing film with energetic ions enhances the performance of the thin-film properties for optical filter applications, including:

- Enhanced optical performance (stable refractive indices and low-absorption) and durability
- Improved film adhesion ionic bombardment of the substrate prior to film deposition
- Densification of the film, deposited on either heated or unheated substrates
- Residual stress modification
- Surface morphology modification (crystal orientation, smoothing, and grain size)

The European R&D organization expressed several mandates for this IR filter development program, including:

- faster, production-scale throughputs
- optimized optical monitoring system (OMS) that used a monochromator with wavelengths that extended out into the IR (minimum of 2.5 microns)
- filter wheel with some predetermined IR wavelength monitoring options
- IR-compatible fiber optic cables and other components of the system
- deposition control, a chip changer designed to prevent shadowing the substrates
- prevention of zinc evaporate upon the resistance sources
- capacity to run large amounts of materials such Ge, which forms a peak as it cools in the crucible and is prone to jamming rotating crucible e-guns.
- enhance adhesion and reduce problems caused by the sticking coefficient

Denton Vacuum’s Integrity series, its cutting-edge e-beam evaporation system platform, accelerated the customer’s development program and met or exceeded their mandates in these important ways:
(1) processed 200 mm wafers, facilitating work on production-scale product
(2) integrated high-capacity, load-lock system enabled rapid testing of alternate process recipes in a controlled vacuum environment, meaning faster turnaround time on device characterization and analysis
(3) employed Denton Vacuum’s LambdaPro® optical monitor to provide precise, real-time control of film properties during the deposition process
(4) enabled Denton’s ProcessPro® control software to track even minute changes across the entire range of process parameters
(7) masked each individual rotating planet, with each mask designed to be stationary under the rotating planet but travelling with the planet around the center of the chamber thus increasing the number of times uniformity is corrected for each substrate, as well as averaging the deposition flux for which correction is made
(8) installed over-sized shutters for resistance sources and hinged covers on the e-guns that lift up to prevent zinc evaporate accumulate from interfering with source operations