MATERION

COATING MATERIAL NEWS

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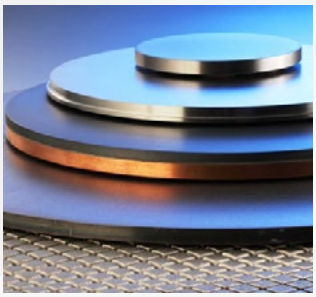
REACTIVE AND NON-REACTIVE DEPOSITION:

Comparison of PVD Processes



Physical vapor deposition (PVD) processes are the most commonly used deposition techniques for the widest variety of materials and coating applications. The process for transforming solid materials into vapors of their atoms requires the addition of energy in order to release atoms from their bonds. The energy source can be thermal, such as that supplied by electron-beam or resistance-heated sources. Or alternatively, the source can be non-thermal vaporization, such as that achieved by high kinetic energy impacting species in sputtering techniques. Depending on the material used, (i.e. metals, metal compounds of oxides or fluorides, or alloys and mixtures), and the desired layer composition, vaporization energy will range from < 1eV to 10's of eV. Vaporization energy is a key parameter in PVD as it relates to reactive vs non-reactive processes.

In the case of the deposition of pure metals, a non-reactive vaporization process is required. The vaporization of compounds results in partial decomposition of the starting compound. When depositing optical thin-film layers, incomplete stoichiometric composition such as sub-oxidation produces absorption and refractive index differences. The presence of absorption is more severe in the UV (ultra violet) than in the IR (infrared) and for coatings that are intended for high laser damage threshold applications. When compounds are to be deposited, reactive processes must be involved. A few common exceptions exist: SiO2, SiO, and Al2O3 can be deposited in a non-reactive environment with acceptable optical and mechanical properties. Read more...

MANUFACTURING CRITICAL OPTICAL COATING MATERIALS:

Silicon and Its Oxide

Within larger industries such as metals, semiconductor and solar, specialty optics thin film engineering is a small but discriminating piece. Whether through sputtering or evaporation processes, engineers strive to optimize thin film properties at the most reasonable cost. In comparison to other metals, Silicon has complex origins and remains fragile and temperamental. Beyond the base material challenges, deposition of high quality PVD SiO2 thin films, whether by reactive sputtering or e-beam evaporation of the oxide, is further constrained by limitations and defects consistent with those techniques. Engineers often focus on predominant limiting factors such as arching, spitting or post-deposition annealing, but other upstream risks often go unnoticed. If only due to their enticing lower cost or their proximity to the bigger semiconductor and solar markets, Silicon and Silicon Oxide can be seen as materials that require more detailed specifications for intense photonics. Read more...

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