Nanostructured coatings: from lab to application

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Abstract

Different nanostructured coatings have been explored by the authors: from solid lubricant coatings, protective coatings and finally anti-reflective coatings.
MoS_x-WC nanostructured coatings have been studied by the authors as a solid lubricant coating to be used in different mechanisms as ball bearings, harmonic drive® gears, etc. These coatings were synteshized by magnetron sputtering and tested under different tribological conditions (different levels of humidity, vacuum and even space). Their structure was a multilayer coating of nanoperiod. Their tribological properties over-performed the pure MoS_x coatings that are the state-of-the art solid lubricant used in space. Finally these coatings were tested in a real component as an harmonic drive® gear showing a great benefit [1].
Multilayered CrAl(Y)N coatings of nanoperiod were deposited on M2 and 316 steel substrates and heated to 1000 ºC in air for 2 h to study their oxidation mechanism and thermal stability. The reactive element effect of Y is confirmed but differs from the typical observed in alloys. The ion interdiffusion of substrate element plays an important role in the oxidation process. The Y presence retards the iron outward diffusion by forming oxides in M2 and yttrium nitride in 316 steels. The microstructural analysis determined that yttrium migrates to the grains and interface of the oxide scale and to the nitride column boundaries. These coatings can be of interest in applications as supercritic steam turbine components [2]
SiO_2 nanostructured Coatings have been synthesized and integrated in a graded-refractive-index multilayer system deposited onto solar glass in order to provide antireflection properties. The coatings are synthesized by sol-gel and evaporation-induced self-assembly (EISA) method and deposited by dip-coating. This technique has permitted to obtain mesostructured porosity and a high control of the void fraction in the coating [3]. Environmental ellipsometric porosimetry (EEP) has proved to be a useful technique to determine porosity (Bruggeman effective medium approximation) and refractive index change with humidity. These measurements provide water adsorption-desorption isotherms thus permitting the calculation of pore size distribution of the coatings [4].
Optical properties (transmittance and reflectance) and mechanical properties (nanohardness, adherence) have been also crucial to select coatings for designing a durable, broadband, scratch resistant, AR system for cover materials in HCPV applications.

References

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