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Optical coatings of tomorrow: From passive interference filters and multifunctional systems towards smart meta-structures - Change of paradigm?

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Optical coating (OC) applications represent a multibillion dollar market worldwide; they range from antireflective (AR) coatings found in most optical components and low emissivity windows in buildings and automobiles to narrowband optical interference filters used in telecommunications. As the range of applications of OCs continuously broadens and extremely attractive market opportunities arise, it is becoming increasingly important to develop new nanostructured thin film materials with specific multifunctional properties. Further progress in this fast evolving field is strongly stimulated by a simultaneous action of two forces: a) the “pulling force” represented by the economic, technological and societal needs, including sustainable development, and b) the “pushing force” related to the curiosity-driven nanotechnology combining new design concepts of materials and devices, fabrication processes and innovative characterization tools, where the only limitation frequently appears to be our imagination.

This presentation will describe a holistic approach to OCs based on a broad and in depth knowledge of the interplay between the design, material, process and performance assessment with respect to specific applications and coating system durability in demanding environments. It will review the progress and future opportunities for the use of discrete, graded, and nanostructurally-controlled architectures benefiting from the nanomaterials’ meta-structures, advanced deposition techniques including high power impulse magnetron sputtering (HiPIMS) and tailored plasma- and ion-surface interactions, as well as complex systems implementing active (smart, tunable) materials.

Tomorrow’s trends will be illustrated by examples from different fields of applications ranging from passive hybrid elastic OC for ophthalmic lenses, hard protective OC for displays, and optical interference filters for gravitational waves detection to active OC and advanced glazings for energy saving using smart windows, active color-shifting security and authentication devices, and smart radiators with self-tuned emissivity for thermal management in satellites.

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