Specially architectured thin films for sensing applications

F. Vaz[1]

IS

[1]Physics Centre of Minho and Porto Universities (CF-UM-UP), University of Minho, 4710-057 Braga, Portugal, LaP-MET—Laboratory of Physics for Materials and Emergent Technologies, University of Minho, 4710-057 Braga, Portugal
fvaz@fisica.uminho.pt

One of the most important goals of nanotechnology is to engineer nanostructures and nanopatterns, paving the way for a society reliant on intentionally designed nanomaterials. This includes specialized domains such as nanoelectronics, nanomedicine, nanomachining, and various other applications based on nanoscale technologies.

Controlling the organization of molecular building blocks at the nanometer scale is of utmost importance, not only for advancing scientific understanding and generating valuable knowledge, but also for pioneering the development of next-generation technological devices with electrical, optical, chemical, or biological improved responses.

Physical Vapor Deposition (PVD) techniques offer great potential for developing nanoarchitectured thin films (nanostructures and nanopatterns) over specific areas of surfaces, machine parts and/or devices. This enables the preparation of solid-state features approaching the molecular length scale. Despite the well-established reliability of PVD techniques, severe requirements of processing are involved, including growing features and nucleation constraints, but also the lack of dimensional variation in the specific systems that are being developed, approaching manufacturing limitations.

In this presentation, the recent developments on specially grown nanostructured thin films will be explored regarding the versatility of the reactive magnetron sputtering technique to tailor the electrical, mechanical and optical properties of different thin films' systems and thus their potential in targeted applications, namely for physical, chemical and biological sensing.

Beyond a comprehensive demonstration of the significant variations in some basic properties of known thin film systems concerning their basic characteristics, this talk will highlight the emerging role of Glancing Angle Deposition (GLAD)-based nanostructures as a versatile platform with extensive sensing capabilities.

In recent years, GLAD-fabricated thin films for sensing applications can replace conventional nanomaterials due to their broad scope, ease of fabrication, controlled growth parameters, and hence, sensing capabilities. The morphological features tailored at the nanoscale exhibit heightened sensitivity, and boast the optical, electrical, thermal, mechanical and tribological properties.