SURFACE ENGINEERING AND VAPOR PHASE TECHNOLOGIES FOR COATING AND FUNCTIONALIZING COMPLEX OBJECTS AND SMALL PARTICLES

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The requirements for materials performance in different areas of application continues to face increased technological, economical and environmental challenges, while considering ever improving materials mechanical, optical, electrical, electrochemical and other functional properties and their combination (multifuntionality). This opens new and exciting opportunities for further development of surface engineering methodologies that allow one to fabricate functional coatings and functionalized surfaces with tailored characteristics. Further progress in this field is only possible when considering a holistic approach in which the desired functions are well understood and closely linked with the materials microstructure and the detailed physical and chemical reactions involved in the processes.

This presentation will describe the progress in surface engineering of materials using chemical vapor deposition, physical vapor deposition, and plasma-enhanced chemical vapor deposition of functional coatings. It will particularly focus on the following aspects:

a) Effect of surface reactions on the evolution of the coating microstructure during the film growth in different pressure regimes ranging from vacuum to the atmospheric pressure.

b) Relationship between the microstructure and the film functional characteristics suitable for different areas of application including optics, aerospace, energy, manufacturing and others.

c) Application of the vapor phase deposition techniques to coat complex objects including small particles. The latter one will be illustrated by our recent results on the development of the fluidized bed chemical vapor deposition process.

Throughout the presentation, we demonstrate the need for advanced diagnostic techniques suitable for the process and materials control on the nanoscale.