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Tutorial #2

Stress generation and evolution during film growth

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The presence of stress in thin films and functional coatings constitutes a major concern in many technological applications, as excessive residual stress levels can dramatically affect the performance, reliability, and durability of material components and devices. This module will start with a description of residual stress sources in PVD thin films, with focus placed on intrinsic stress. Stress evolutions during film growth will be presented, and the underlying atomistic and microscopic mechanisms will be discussed in the framework of existing analytical models. Experimental methods for measuring stress in thin films will be reviewed, with main emphasis on wafer-curvature. The influence of growth conditions on intrinsic stress, such as kinetics (substrate temperature and deposition flux), energetics (working pressure, bias voltage) will be addressed together with the role of impurities and alloying effects. Finally, strategies to control and mitigate stress for specific applications will be proposed.

About the lecturer

Gregory Abadias is Professor at the Physics Department of the University of Poitiers, and Deputy Director of the Department of Physics and Mechanics of Materials, at CNRS Pprime Institute, France. He received his Ph.D. degree in materials science in 1998 at National Polytechnic Institute of Grenoble (INPG), and he is currently group leader of thin films activities at Pprime Institute. His current research interests focus on the understanding of thin film growth dynamics using real-time and in situ diagnostics as well as computational modelling, with main emphasis on growth manipulation strategies to control morphology and stress development in sputter-deposited metallic layers, including compositionally complex alloys. He has co-authored more than 160 papers in peer-review journals and one book chapter on stress in PVD thin films. He was the French representative of the Surface Engineering Division of IUVSTA for 2022-25 triennium. He serves as Editor of Surface and Coatings Technology journal since 2016.