SHORT COURSES

SHORT COURSE ON « STRESS EVOLUTION DURING THIN FILM GROWTH »

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Thin films produced by physical vapor deposition (PVD) techniques are usually under a stressed state, due to the mechanical constraint imposed macroscopically by the substrate on which they are deposited. Several factors are affecting the resulting stress state, which can be either tensile or compressive, with magnitude up to several GPa. The understanding and control of stress development in thin films is essential, especially for nanoscale systems, to ensure device integrity.

The course will start with a description of residual stress sources in PVD thin films, with main focus placed on intrinsic stress. Stress evolutions during film growth and post-deposition treatments will be presented, and the underlying atomistic and microscopic mechanisms discussed in the frame of a kinetic model. Experimental assessment of stress in thin films will be reviewed, based on recent advances in optical and X-ray diffraction techniques, allowing a depth-sensitive determination as well as real-time diagnostics. The influence of microstructure (grain size, texture) and deposition process parameters on the stress development in PVD hard coatings will be outlined. The role of energetic species, involved during magnetron sputtering or ion-beam assisted deposition, on the compressive stress build-up will be highlighted. Finally, strategies to control stress and stress engineering for specific applications will be proposed.