

PO4061

Acoustic emission as a tool for extended tribo-mechanical characterization at nano/micro scale – application to nanoindentation and scratch testRadim Ctvrtlik¹, Jan Tomastik¹, Martin Drab², Vaclav Koula²¹Palacky University, Olomouc, Czech Republic ²ZD Rpety - Dakel, Prague, Czech Republic

ctvrtlik@fzu.cz

Nanoindentation and scratch test have been established as standard tests for exploring mechanical and tribological properties of thin films and coatings. Evaluation of these tests mainly relies on the analysis of depth-load-time records. This approach has been proven to be sufficient in most cases for a variety of materials (thin films, micro-objects, composites, bulk). However there are many situations where indentation curves or scratch depth-load-time records do not provide sufficient information for a complex understanding of the deformation response of the material. Although microscopic observation of the residual indents or scratches extends the tests' evaluation it does not elucidate the dynamics of the process or phenomenon studied, especially for non/transparent materials. On the other hand the recording of the acoustic waves can overcome this drawback and offer a nondestructive way for obtaining complementary information. In general, acoustic waves emitted during the mechanical tests at the nano-micro scale are a rich source of information about the deformation behavior of the tested material. This holds especially for the initiation and propagation of cracks in the tested surface or coating in particular. Hence analysis of acoustic emissions (AE) provides a better understanding and more complex interpretation of the results obtained by the nanoindentation and scratch test. The strength of the AE based method will be demonstrated for hard protective SiC, SiCN, CrN and AlCrN coatings magnetron sputtered on silicon and tungsten carbide explored via scratch test. Combination of AE and nanoindentation will be presented for silicon and various types of glass. The complementary analysis of the time and frequency domain will draw the potential of the AE extended approach. Especially dynamics of the failure and fracture processes will be distinguished and elucidated. In both cases the analysis of AE events will be correlated with standard approaches.

Keywords

Acoustic emission

Scratch test

Nanoindentation

Thin films