NANOINDENTATION INDUCED REVERSIBLE PLASTICITY DETECTED BY ACOUSTIC EMISSION

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Acoustic emission (AE) detection coupled with nanoindentation represents a very powerful combination of complementary methods providing a unique set of information about the deformation behavior of materials at small scales. The plastic instabilities of a silicon iron single crystal were explored via spherical nanoindentation together with an acoustic emission detection at the nanoscale [1]. Besides gradually developing plasticity without detectable AE activity and sudden onset of plasticity (pop-in) with a strong AE event, an elastic response with frequent AE activity both during loading and unloading was observed. This type of AE activity at the nanoscale was observed for the first time for purely elastic indentations and it suggests an action of reversible twinning. The reversible character of these events was confirmed by the analysis of the AE hit waveform.

Critical indentation stresses were identified for loading and unloading and together with AE hit parameters enabled unambiguous classification of observed events. Acoustic emissions proved to be a very powerful and complementary method for the examination and classification of different deformation mechanisms (slip and twinning) observed during indentation loading.

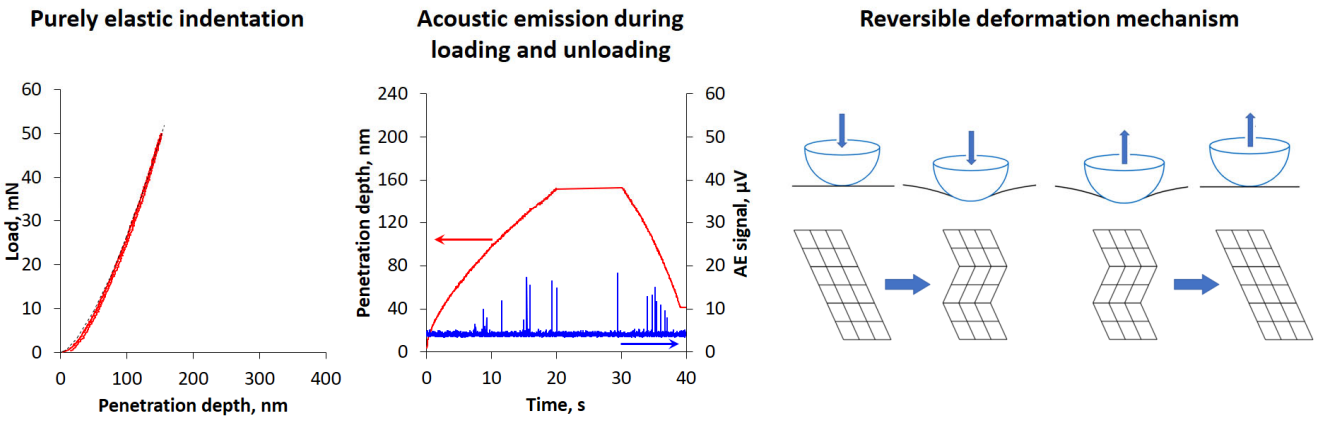

Figure 1 – Acoustic emission detected for purely elastic indentation curve

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[1] R. Čtvrtlík, J. Čech, J. Tomáštík, L. Václavek, P. Haušild, Plastic instabilities explored via acoustic emission during spherical nanoindentation, *Materials Science and Engineering A* 841 (2022), 143019, 20 p.