MEASUREMENT OF MECHANICAL PROPERTIES OF 1-D NANOSTRUCTURES USING ATOMIC FORCE MICROSCOPY

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1-D nanostructures (e.g. nanowires, nanotubes) have attracted a lot of attention during the last decayed due to their unique properties and small sizes making them perfect components for composite materials, nanoelectronics, photonics, sensors, actuators and photovoltaics. In many of these applications, 1-D nanostructures are subjected to mechanical stresses and repeated loading. Therefore, it is imperative to characterize the mechanical properties of 1-D nanostructures. Recently, different nanomanipulation techniques including nanotensile test, three-point bending, cantilever beam bending, nanoindentation and resonance method have been used for mechanical characterization of 1-D nanostructures. Nanomanipulation can be carried out either inside an electron microscopy (EM) or using an atomic force microscopy (AFM).

In the current study, AFM is used to perform three-point bending, cantilever beam bending and nanoindentation to measure the mechanical properties of SiO_2 nanotubes [1], ZnO [2] and Co doped ZnO nanowires [3], Ag-Al_2O_3 and Au-Al_2O_3 core-shell nanowires. Obtained results will be presented and analysed. Furthermore, advantages and disadvantages of each method will be discussed.

References

1. B. Polyakov, M. Antsov, S. Vlassov, L. M. Dorogin, M. Vahtrus, R. Zabels, S. Lange, R. Lõhmus, 2014, *Belstein Journal of Nanotechnology*, 5, 1808-1814.
2. S. Vlassov, B. Polyakov, S. Oras, M. Vahtrus, M. Antsov, A. Šutka, K. Smits, L. M. Dorogin, R. Lõhmus, 2016, *Nanotechnology*, 27, 335701.
3. M. Vahtrus, A. Šutka, B. Polyakov, S. Oras, M. Antsov, N. Doebelin, R. Lõhmus, E. Nõmmiste, S. Vlassov, 2016, *Materials Characterization*, 121, 40-47.

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