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Experimental investigation of Euler's elastica: in-situ SEM nanowire post-buckling

*Eksperymentalna i teoretyczna ocena stateczności sprężystej nanopręt*ów

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The Euler Buckling Formula (EBF), which gives the critical value of the compressive load required to buckle a long slender rod, is widely used mainly by structural and mechanical engineers. On the other hand, on the microscopic or nano-scale levels, the non-linear elastic stability processes become a subject of wide interest. The increasing demand for nanomaterials with extraordinary properties, e.g. elastic ones, requires mechanical behaviour description. Based on the nonlinear elasticity theory, this research studied the post-buckling behaviour of simply supported nanowires. Nanowires with various length-to-diameter ratios were examined, and the effect of geometrical parameters was discussed. The results demonstrated that the mid-span deflection increases by increasing the length-to-diameter ratio. Also, it is observed that the displacement of the end of the nanowire is aspect-ratio dependent. It was shown that, in general, Euler's Buckling Formula should apply in predicting the shape of elastica (Fig. 1).

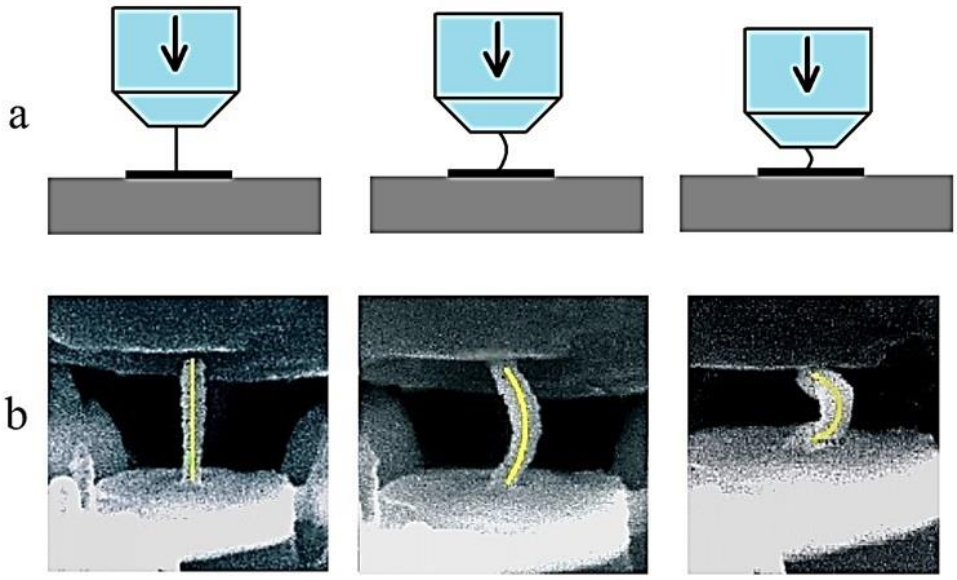

Figure 1. Three buckling stages: a) scheme of compression of a single nanowire with the use of a flat tip nanoindenter b) SEM images with marked predicted deformed elastic lines.

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