

Central Office of Measures

<https://www.gum.gov.pl/en/about/news/353,Article-by-the-Central-Office-of-Measures039s-metrologist-in-the-journal-Ultrami.html>
14.03.2026, 10:02

Article by the Central Office of Measures's metrologist in the journal Ultramicroscopy

Published by: Adam Żeberkiewicz

Research on atomic force microscopy in mechanical measurements of single nanowires is the subject of an article published in the scientific journal "Ultramicroscopy" in May 2024.

The article was created as a result of the implementation of the European project [19ENG05 NanoWires](#), which aims to determine the traceable measurement and characterization of energy harvesting devices based on vertical NWs.

Ultramicroscopy 263 (2024) 113985



Contents lists available at [ScienceDirect](#)

Ultramicroscopy

journal homepage: www.elsevier.com/locate/ultramic



Atomic force microscopy in mechanical measurements of single nanowires

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Bartosz C. Pruchnik, Janusz D. Fidelus, Ewelina Gacka, Krystyna Mika, Leszek Zaraska, Grzegorz D. Sulka, Teodor P. Gotszalk.: „[Atomic force microscopy in mechanical measurements of single nanowires](#)”, *Ultramicroscopy* 263 (2024) 113985, ISSN 0304-3991, <https://doi.org/10.1016/j.ultramic.2024.113985>.

Abstract:

In this paper, we present the results of mechanical measurement of single nanowires (NWs) in a repeatable manner. Substrates with specifically designed mechanical features were used for NW placement and localization for measurements of properties such as Young's modulus or tensile strength of NW with an atomic force

microscopy (AFM) system. Dense arrays of zinc oxide (ZnO) nanowires were obtained by one-step anodic oxidation of metallic Zn foil in a sodium bicarbonate electrolyte and thermal post-treatment. ZnO NWs with a hexagonal wurtzite structure were fixed to the substrates using focused electron beam-induced deposition (FEBID) and were annealed at different temperatures *in situ*. We show a 10-fold change in the properties of annealed materials as well as a difference in the properties of the NW materials from their bulk values with pre-annealed Young modulus at the level of 20 GPa and annealed reaching 200 GPa. We found the newly developed method to be much more versatile, allowing for *in situ* operations of NWs, including measurements with different methods of scanning probe microscopy.

The [19ENG05 NanoWires](#) project is funded under the European Metrology Innovation and Research Program (EMPIR).



The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States