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Silicon nanowires: fabrication and quantitative dimensional characterisation by AFM

Luigi Ribotta (1,2), Alexandra Delvallée (3), Eleonora Cara (2,4), Roberto Bellotti (1), Andrea Giura (1), Ivan De Carlo (4,6), Matteo Fretto (4), Walter Knulst (5), Richard Koops (5), Bruno Torre (4,6), Zineb Saghi (7), Luca Boarino (4)

(1) Applied Metrology and Engineering Division, Istituto Nazionale di Ricerca Metrologica (INRiM), Strada delle Cacce 91, 10135, Turin, Italy

(2) PiQuET – Piemonte Quantum Enabling Technology, Istituto Nazionale di Ricerca Metrologica (INRiM), Strada delle Cacce 91, 10135, Turin, Italy

(3) LNE, Laboratoire National de métrologie et d'Essais, 29 avenue Roger Hennequin, 78190 Trappes, France

(4) Advanced Materials and Life Science Metrology Division, Istituto Nazionale di Ricerca Metrologica (INRiM), Strada delle Cacce 91, 10135, Turin, Italy

(5) VSL, National Metrology Institute, Thijssseweg 11, 2629 JA Delft, The Netherlands

(6) Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129, Turin, Italy

(7) University of Grenoble Alpes, CEA, Leti, F-38000 Grenoble, France

Silicon nanowires (NWs) are fabricated by means of nanosphere lithography and metal-assisted chemical etching (MACE) to obtain high aspect ratio nanostructures.

This study reports an interlaboratory comparison on the measurements of dimensional parameters of nanowires by AFMs among some European National Metrology Institutes, since robust methods to measure nanowires is lacking.

The measurands investigated are NW diameter (measured as top-height) and sidewall roughness (Ra, Rq, Rz, Rsk, Rku parameters), extracted from the top profile along the nanowire length. In fact, both are key parameters to understand if the fabrication process was carried out in a correct way. Moreover, the knowledge of these parameters is essential to achieve the expected functional characteristic of energy harvesting systems.

In this work the reproducibility due to different instruments of exactly the same set of nanowires are studied.

Measurements show a good agreement, with a combined standard uncertainty of the diameter less than 3%, and well within 5% for Ra and Rq values. Concerning the roughness, no standard or guide exists for assessing the uncertainty associated with it, so we propose and investigate a new methodology based on Monte-Carlo approach.

Corresponding author's contact and billing information:

- Istituto Nazionale di Ricerca Metrologica (INRiM)
- Strada delle Cacce 91, 10135, Torino, Italy
- l.ribotta@inrim.it
- +39 011 3919 960
- VAT number: 09261710017
- PEC: inrim@pec.it