

## High-throughput, parallel atomic force microscope

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Atomic force microscopy (AFM) is an essential nanoinstrument technique for several applications such as cell biology and nanoelectronics metrology and inspection. The need for statistically significant sample sizes means that data collection can be an extremely lengthy process in AFM. The use of a single AFM instrument is known for its very low speed and not being suitable for scanning large areas, resulting in very-low-throughput measurement. We address this challenge by parallelizing AFM instruments. The parallelization is achieved by miniaturizing the AFM instrument and operating many of them simultaneously. This nanoinstrument has the advantages that each miniaturized AFM can be operated independently and that the advances in the field of AFM, both in terms of speed and imaging modalities, can be implemented more easily. Moreover, a parallel AFM instrument also allows one to measure several physical parameters simultaneously; while one instrument measures nano-scale topography, another instrument can measure mechanical, electrical or thermal properties, making it a Lab-on-an-Instrument. In this paper, a proof of principle (PoP) of such a parallel AFM instrument has been demonstrated by analyzing the topography of large samples such as semiconductor wafers. This nanoinstrument provides new research opportunities in the nanometrology of wafers and nanolithography masks by enabling real die-to-die and wafer-level measurements and in cell biology by measuring the nano-scale properties of a large number of cells.

### Biography:

Dr. Hamed Sadeghian received his PhD (Cum Laude) in 2010 from Delft University of Technology. He then continued his career as a research associate and develop several nano-opto-mechanical instruments for nano-scale interaction measurement. He is currently one of the Principal Scientists at TNO. His research group NOMI focuses on development of Instruments where the core is based on interaction of electromagnetic or mechanical waves with matters, with a focus on industrial and societal applications. Examples are development of the parallel AFM as a sub-nm, high throughput metrology and inspection solution for Semiconductor industry, high resolution optical microscopy with metainstruments and 3D nanotomography to resolve invisible nanostructures under the surface. He is also the scientific leader of Early research program (ERP) 3D nanomanufacturing Instruments at TNO. In the last 5 years he has participated in several European Union funded projects and proposals, such as E450EDL, E450LMDAP, SenaTe, Value4Nano and 3DAM.

In 2014 he also received his MBA degree from Leuven Vlerick Business School, Belgium. He was also a co-founder of Jahesh Poulad Co. (2002), which designs, manufactures and installs mechanical and electrical equipment for steel industries.

Dr. Sadeghian holds more than 30 patents, and has authored more than 50 technical papers and co-authored a book. He is a member of editorial advisory board of Sensors & Transducers Journal. He is also a member of technical committee of SENSORDEVICES conference since 2010 till present. He is also a recipient of several best paper awards. In 2012 he was awarded as "TNO excellent researcher".