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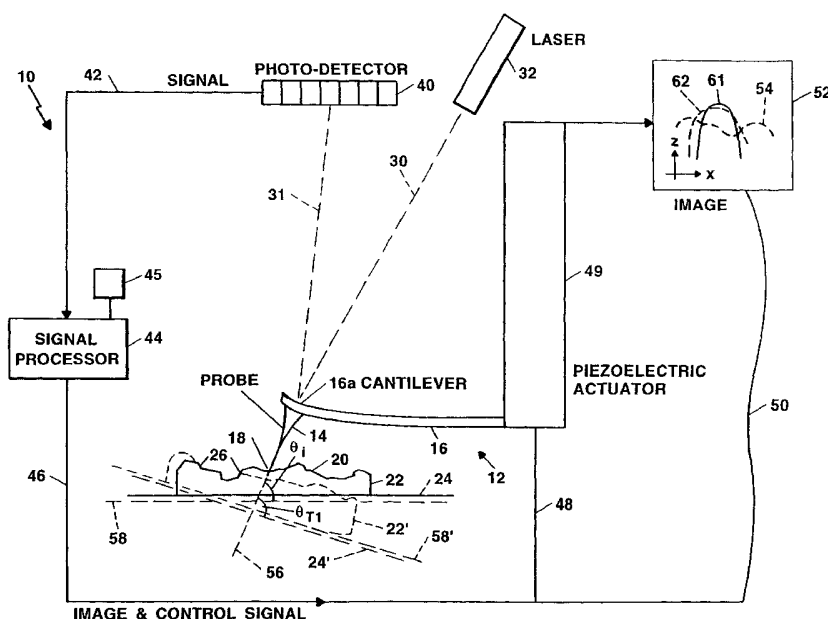
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- (72) Inventors: AUMOND, Bernardo, D.; 148 Spring Street, Cambridge, MA 02141 (US). YUCEF-TOUMI, Kamal; 25 Magnolia Avenue, Cambridge, MA 02138 (US). For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: IMAGE DECONVOLUTION TECHNIQUES FOR PROBE SCANNING APPARATUS



(57) Abstract: An apparatus and method are provided for processing the images obtained from an atomic force microscopy when profiling high aspect ratio features. A deconvolution technique for deconvolving the sample image includes the use of multiple images but does not require exact calibration of the scanning probe. In one embodiment, erosion and dilation techniques are used to obtain an undistorted image of the sample being measured. In another embodiment, Legendre transforms are used to obtain an undistorted image of the sample being measured. Also described is a technique for measuring the tip radius of the scanning probe.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/05434

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06T5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G06T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PINGALI G S ET AL: "Estimation of sample and probe tilts in scanning probe microscopy" PROCEEDINGS OF THE INSTRUMENTATION AND MEASUREMENT TECHNOLOGY CONFERENCE. ORVINE, CA., MAY 18 - 20, 1993, NEW YORK, IEEE, US, 18 May 1993 (1993-05-18), pages 327-332, XP010131493 ISBN: 0-7803-1229-5 page 327, paragraph 1 -page 328, paragraph 2 page 330, paragraph 5	1,2,18, 21
Y	--- -/--	3-17,19, 20,22

☒ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 01/05434

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	VILLARRUBIA, J.S.: "Morphological estimation of tip geometry for scanned probe microscopy" SURFACE SCIENCE, vol. 321, 1994, pages 287-300, XP008006735 cited in the application abstract page 294, paragraph 3.3 -page 297, paragraph 4 ---	3-6, 19, 22
Y	KELLER D: "RECONSTRUCTION OF STM AND AFM IMAGES DISTORTED BY FINITE-SIZE TIPS" SURFACE SCIENCE, NORTH-HOLLAND PUBLISHING CO, AMSTERDAM, NL, vol. 253, 1991, pages 353-364, XP000601062 ISSN: 0039-6028 page 355, paragraph 3 page 357, paragraph 5 - paragraph 6 ---	7-17, 20
A	AUMOND B D ET AL: "Experimental high precision profilometry of high aspect ratio samples" SYSTEMS, MAN, AND CYBERNETICS, 1998. 1998 IEEE INTERNATIONAL CONFERENCE ON SAN DIEGO, CA, USA 11-14 OCT. 1998, NEW YORK, NY, USA, IEEE, US, 11 October 1998 (1998-10-11), pages 4435-4440, XP010311218 ISBN: 0-7803-4778-1 page 4439, paragraph 7 -page 4440, paragraph 8 ---	3, 13
A	PINGALI G S ET AL: "Restoration of scanning probe microscope images" APPLICATIONS OF COMPUTER VISION, PROCEEDINGS, 1992., IEEE WORKSHOP ON PALM SPRINGS, CA, USA 30 NOV.-2 DEC. 1992, LOS ALAMITOS, CA, USA, IEEE COMPUT. SOC, US, 30 November 1992 (1992-11-30), pages 282-289, XP010029137 ISBN: 0-8186-2840-5 cited in the application abstract page 283, right-hand column, line 1 - paragraph 3 page 286, right-hand column -----	3-5, 7, 8, 18-22