

Benjamin W. Chui

**MICROCANTILEVERS  
FOR ATOMIC FORCE  
MICROSCOPE  
DATA STORAGE**



Kluwer Academic Publishers

# Microcantilevers For Atomic Force Microscope Data Storage Microsystems

**Who's Who Marquis, Marquis Who's Who**

## **Microcantilevers For Atomic Force Microscope Data Storage Microsystems:**

Microcantilevers for Atomic Force Microscope Data Storage Benjamin W. Chui,2012-12-06 Microcantilevers for Atomic Force Microscope Data Storage describes a research collaboration between IBM Almaden and Stanford University in which a new mass data storage technology was evaluated This technology is based on the use of heated cantilevers to form submicron indentations on a polycarbonate surface and piezoresistive cantilevers to read those indentations Microcantilevers for Atomic Force Microscope Data Storage describes how silicon micromachined cantilevers can be used for high density topographic data storage on a simple substrate such as polycarbonate The cantilevers can be made to incorporate resistive heaters for thermal writing or piezoresistive deflection sensors for data readback The primary audience for Microcantilevers for Atomic Force Microscope Data Storage is industrial and academic workers in the microelectromechanical systems MEMS area It will also be of interest to researchers in the data storage industry who are investigating future storage technologies

**Microfluidics and BioMEMS Applications** Francis E. H. Tay,2013-04-17 Microfluidics and BioMEMS Applications central idea is on microfluidics a relatively new research field which finds its niche in biomedical devices especially on lab on a chip and related products Being the essential component in providing driving fluidic flows an example of micropump is chosen to illustrate a complete cycle in development of microfluidic devices which include literature review designing and modelling fabrication and testing A few articles are included to demonstrate the idea of tackling this research problem and they cover the main development scope discussed earlier as well as other advanced modelling schemes for microfluidics and beyond Scientists and students working in the areas of MEMS and microfluidics will benefit from this book which may serve both communities as both a reference monograph and a textbook for courses in numerical simulation and design and development of microfluidic devices

**Micromachined Mirrors** Robert Conant,2013-04-17 Micromachined Mirrors provides an overview of the performance enhancements that will be realized by miniaturizing scanning mirrors like those used for laser printers and barcode scanners and the newly enabled applications including raster scanning projection video displays and compact high speed fiber optic components There are a wide variety of methods used to fabricate micromachined mirrors each with its advantages and disadvantages There are however performance criteria common to mirrors made from any of these fabrication processes For example optical resolution is related to the mirror aperture the mirror flatness and the scan angle Micromachined Mirrors provides a framework for the design of micromirrors and derives equations showing the fundamental limits for micromirror performance These limits provide the micromirror designer tools with which to determine the acceptable mirror geometries and to quickly and easily determine the range of possible mirror optical resolution and scan speed

*Heat Convection in Micro Ducts* Yitshak Zohar,2013-03-09 As the field of Microsystems expands into more disciplines and new applications such as RF MEMS Optical MEMS and Bio MEMS thermal management is becoming a critical issue in the operation of many microdevices including microelectronic chips Heat Convection in Micro

Ducts focuses on the fundamental physics of convective heat transfer in microscale and specific applications such as microchannel heat sinks micro heat pipes microcoolers and micro capillary pumped loops This book will be of interest to the professional engineer and graduate student interested in learning about heat removal and temperature control in advanced integrated circuits and microelectromechanical systems

**Bringing Scanning Probe Microscopy up to Speed** Stephen C. Minne, Scott R. Manalis, Calvin F. Quate, 2012-12-06 Bringing Scanning Probe Microscopy Up to Speed introduces the principles of scanning probe systems with particular emphasis on techniques for increasing speed The authors include useful information on the characteristics and limitations of current state of the art machines as well as the properties of the systems that will follow in the future The basic approach is two fold First fast scanning systems for single probes are treated and second systems with multiple probes operating in parallel are presented The key components of the SPM are the mechanical microcantilever with integrated tip and the systems used to measure its deflection In essence the entire apparatus is devoted to moving the tip over a surface with a well controlled force The mechanical response of the actuator that governs the force is of the utmost importance since it determines the scanning speed The mechanical response relates directly to the size of the actuator smaller is faster Traditional scanning probe microscopes rely on piezoelectric tubes of centimeter size to move the probe In future scanning probe systems the large actuators will be replaced with cantilevers where the actuators are integrated on the beam These will be combined in arrays of multiple cantilevers with MEMS as the key technology for the fabrication process

**Optical Microscanners and Microspectrometers using Thermal Bimorph Actuators** Gerhard Lammel, Sandra Schweizer, Philippe Renaud, 2002-01-31 Optical Microscanners and Microspectrometers using Thermal Bimorph Actuators shows how to design and fabricate optical microsystems using innovative technologies and original architectures A barcode scanner laser projection mirror and a microspectrometer are explained in detail starting from the system conception discussing simulations choice of cleanroom technologies design fabrication device test packaging all the way to the system assembly An advanced microscanning device capable of one and two dimensional scanning can be integrated in a compact barcode scanning system composed of a laser diode and adapted optics The original design of the microscanner combines efficiently the miniaturized thermal mechanical actuator and the reflecting mirror providing a one dimensional scanning or an unique combination of two movements depending on the geometry The simplicity of the device makes it a competitive component The authors rethink the design of a miniaturized optical device and find a compact solution for a microspectrometer based on a tunable filter and a single pixel detector A porous silicon technology combines efficiently the optical filter function with a thermal mechanical actuator on chip The methodology for design and process calibration are discussed in detail The device is the core component of an infrared gas spectrometer

*Optimal Synthesis Methods for MEMS* S.G.K. Ananthasuresh, 2012-12-06 The field of microelectromechanical systems or MEMS has gradually evolved from a discipline populated by a small group of researchers to an enabling technology supporting a variety of products in such

diverse areas as mechanical and inertial sensors optical projection displays telecommunications equipment and biology and medicine Critical to the success of these products is the ability to design them and this invariably involves detailed modeling of proposed designs Over the past twenty years such modeling has become increasingly sophisticated with full suites of MEMS oriented computer aided design tools now available worldwide But there is another equally important side to the design process In my own book *Microsystem figuring out what to build in the first place Design I* chose to emphasize the modeling aspect of design The task of figuring out what to build was defined by a vague step called creative thinking I used practical product examples to illustrate the many subtle characteristics of successful designs but I made no attempt to systematize the generation of design proposals or optimized designs That systemization is called synthesis which is the subject of this book

**Sci-tech News**, 1999 **Cumulated Index to the Books**, 1999 *Solid-State Sensors, Actuators, and Microsystems Workshop*, 2010, 2010 **American Book Publishing Record**, 1999 Subject Guide to Books in Print, 1991 The British National Bibliography Arthur James Wells, 1999 Brinkman's catalogus van boeken en tijdschriften, 2001 With 1901 1910 1956 1960 Repertorium is bound Brinkman's Titel catalogus van de gedurende 1901 1910 1956 1960 Title varies slightly Brinkman's cumulatieve catalogus van boeken, 1999 Voorts een alfabetische lijst van Nederlandsche boeken in België uitgegeven Advanced Silicon Micromachined Cantilevers for Atomic Force Microscope Data Storage Benjamin Wai-Ho Chui, 1998 Who's Who in Science and Engineering 2008-2009 Who's Who Marquis, Marquis Who's Who, 2007-12 *Boekblad*, 1999 CMOS Cantilever Sensor Systems D. Lange, O. Brand, Henry Baltes, 2002-07-23 This book introduces the use of industrial CMOS processes to produce arrays of nanomechanical cantilever transducers with on chip driving and signal conditioning circuitry These cantilevers are familiar from Scanning Probe Microscopy SPM and allow the sensitive detection of physical quantities such as forces and mass changes The book is divided into three parts First fabrication aspects and the mechanisms of cantilever resonators are introduced Of the possible driving and sensing mechanisms electrothermal and magnetic excitation as well as piezoresistive detection and the use of MOS transistors for the deflection detection are introduced This is followed by two application examples The use of resonant cantilevers for the mass sensitive detection of volatile organic compounds and force sensor arrays for parallel Scanning Atomic Force Microscopy AFM of large areas

**Design and Fabrication of a Nanocantilever for High-speed Force Microscopy** Jennifer Maureen Campbell, 2009 The atomic force microscope AFM has become an important tool in many fields ranging from materials science to biology The central component of the AFM is a probe consisting of a soft cantilever to which a sharp tip is attached By scanning the probe over the surface of a sample and measuring small deflections of the cantilever atomic resolution images can be obtained for both conducting and non conducting samples Unfortunately the scan speed of conventional AFM is limited such that several minutes are required to obtain a high quality image If the scan speed of the AFM could be increased to allow for dynamic imaging it could be used for many new applications in materials science

life science and process control Much of the current work toward high speed AFM has involved improvements to scanners and electronics Innovative scanner design and control has resulted in operational frequencies up to 1 MHz while specialized electronics has pushed the feedback bandwidth up to 100 MHz To realize the full potential of these systems a cantilever with a resonance frequency much greater than 100 MHz is required Unfortunately current microfabrication techniques used to produce AFM cantilevers limits the fundamental resonance frequency to several MHz The purpose of this project was to miniaturize a cantilever into the nanometer regime allowing for increased resonance frequencies Three modeling methods were used to design a 200 MHz silicon nitride cantilever suitable for integration into an atomic resolution frequency modulation AFM A process was developed to fabricate the cantilever coupled to an atomic point contact APC displacement detector The cantilever mask and APC electrodes were defined through electron beam lithography and double angle evaporation The cantilever pattern was transferred to the nitride layer through focused ion beam milling a subsequent wet etch into the underlying Si substrate suspended the structure Then using an active feedback system electromigration was used to form the APC at 77 K and  $10^{-6}$  Torr Progress was also made toward measuring cantilever motion with the APC displacement detector through microwave reflectometry

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