

Benjamin W. Chui

**MICROCANTILEVERS
FOR ATOMIC FORCE
MICROSCOPE
DATA STORAGE**



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Microcantilevers For Atomic Force Microscope Data Storage Microsystems

Benjamin W. Chui



Microcantilevers For Atomic Force Microscope Data Storage Microsystems:

Microcantilevers for Atomic Force Microscope Data Storage Benjamin W. Chui, 1998-10-31 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

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

Microfabrication in Tissue Engineering and Bioartificial Organs Sangeeta N. Bhatia, 1999-08-31 The Microsystems Series has as its goal the creation of an outstanding set of textbooks references and monographs on subjects that span the broad field of microsystems Exceptional PhD dissertations provide a good starting point for such a series because unlike monographs by more senior authors which must compete with other professional duties for attention the dissertation becomes the sole focus of the author until it is completed Conversion to book form is then a streamlined process with final editing and book production completed within a few months Thus we are able to bring important and timely material into book form at a pace which tracks this rapidly developing field Our first four books in the series were drawn from the more physics oriented side of the microsystems field including such diverse subjects as computer aided design atomic force microscopy and ultrasonic motion detection Now with Sangeeta Bhatia s work we enter the realm of biology Her use of artificially structured substrates to encourage the liver cells to form orderly assemblies is a fine example of how microfabrication technology can contribute to cell biology and medicine I am pleased to be able to add this very new and very

interesting work to the Microsystems Series Stephen D Senturia Cambridge MA Microfabrication in Tissue Engineering and Bioartificial Organs Foreword One of the emerging applications of microsystems technology in biology and medicine is in the field of tissue engineering and artificial organs In order to function cells need to receive proper signals from their environment

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

Microscale Heat Conduction in Integrated Circuits and Their Constituent Films Y. Sungtaek Ju, Kenneth E. Goodson, 2012-12-06 The study of thermal phenomena in microdevices has attracted significant attention recently The interdisciplinary nature of this topic however makes it very difficult for researchers to fully understand details of research results presented in journal articles For many researchers intending to be active in this field therefore a more comprehensive treatment complete with sufficient background information is urgently needed Advances in semiconductor device technology render the thermal characterization and design of ICs increasingly more important The present book discusses experimental and theoretical studies of heat transfer in transistors and interconnects A novel optical thermometry technique captures temperature fields with high temporal and spatial failures in devices that are subjected to electrical overstress EOS and electrostatic discharge ESD Also reported are techniques for determining the thermal transport properties of dielectric passivation layers and ultra thin silicon on insulator SOI layers Theoretical analysis on the data yields insight into the dependence of thermal properties on film processing conditions The techniques and data presented here will greatly aid the thermal engineering of interconnects and transistors

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

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.

Scanning Probe Lithography Hyongsok T. Soh, Kathryn Wilder Guarini, Calvin F. Quate, 2013-03-14

Scanning Probe Lithography SPL describes recent advances in the field of scanning probe lithography a high resolution patterning technique that uses a sharp tip in close proximity to a sample to pattern nanometer scale features on the sample. SPL is capable of patterning sub 30nm features with nanometer scale alignment registration. It is a relatively simple inexpensive reliable method for patterning nanometer scale features on various substrates. It has potential applications for nanometer scale research for maskless semiconductor lithography and for photomask patterning. The authors of this book have been key players in this exciting new field. Calvin Quate has been involved since the beginning in the early 1980s and leads the research team that is regarded as the foremost group in this field. Hyongsok Tom Soh and Kathryn Wilder Guarini have been the members of this group who in the last few years have brought about remarkable series of advances in SPM lithography. Some of these advances have been in the control of the tip which has allowed the scanning speed to be increased from $\mu\text{m/s}$ to mm/s . Both non contact and in contact writing have been demonstrated as has controlled writing of sub 100 nm lines over large steps on the substrate surface. The engineering of a custom designed MOSFET built into each microcantilever for individual current control is another notable achievement. Micromachined arrays of probes each with individual control have been demonstrated. One of the most intriguing new aspects is the use of directly grown carbon nanotubes as robust high resolution emitters. In this book the authors concisely and authoritatively describe the historical context the relevant inventions and the prospects for eventual manufacturing use of this exciting new technology.

Materials & Process Integration for MEMS Francis E.

H. Tay, 2013-06-29 The field of materials and process integration for MEMS research has an extensive past as well as a long and promising future. Researchers, academicians, and engineers from around the world are increasingly devoting their efforts on the materials and process integration issues and opportunities in MEMS devices. These efforts are crucial to sustain the long-term growth of the MEMS field. The commercial MEMS community is heavily driven by the push for profitable and sustainable products. In the course of establishing high-volume and low-cost production processes, the critical importance of materials properties, behaviors, reliability, reproducibility, and predictability, as well as process integration of compatible materials systems, become apparent. Although standard IC fabrication steps, particularly lithographic techniques, are leveraged heavily in the creation of MEMS devices, additional customized and novel micromachining techniques are needed to develop sophisticated MEMS structures. One of the most common techniques is bulk micromachining, by which micromechanical structures are created by etching into the bulk of the substrates with either anisotropic etching with strong alkali solution or deep reactive ion etching (DRIE). The second common technique is surface micromachining, by which planar microstructures are created by sequential deposition and etching of thin films on the surface of the substrate, followed by a final removal of sacrificial layers to release suspended structures. Other techniques include deep lithography and plating to create metal structures with high aspect ratios. LIGA (micro electro discharge machining) is another technique.

Micromachined Ultrasound-Based Proximity Sensors Mark R. Hornung, Oliver Brand, 2012-12-06 *Micromachined Ultrasound Based Proximity Sensors* presents a packaged ultrasound microsystem for object detection and distance metering based on micromachined silicon transducer elements. It describes the characterization, optimization, and the long-term stability of silicon membrane resonators, as well as appropriate packaging for ultrasound microsystems. *Micromachined Ultrasound Based Proximity Sensors* describes a cost-effective approach to the realization of a micro electro mechanical system (MEMS). The micromachined silicon transducer elements were fabricated using industrial IC technology combined with standard silicon micromachining techniques. Additionally, this approach allows the co-integration of the driving and read-out circuitry. To ensure the industrial applicability of the fabricated transducer elements, intensive long-term stability and reliability tests were performed under various environmental conditions, such as high temperature and humidity. Great effort was undertaken to investigate the packaging and housing of the ultrasound system, which mainly determine the success or failure of an industrial microsystem. A low-stress mounting of the transducer element minimizes thermomechanical stress influences. The developed housing not only protects the silicon chip but also improves the acoustic performance of the transducer elements. The developed ultrasound proximity sensor system can determine object distances up to 10 cm with an accuracy of better than 0.8 mm. *Micromachined Ultrasound Based Proximity Sensors* will be of interest to MEMS researchers as well as those involved in solid-state sensor development.

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