



Agilent Nano Indenter G300

Data Sheet

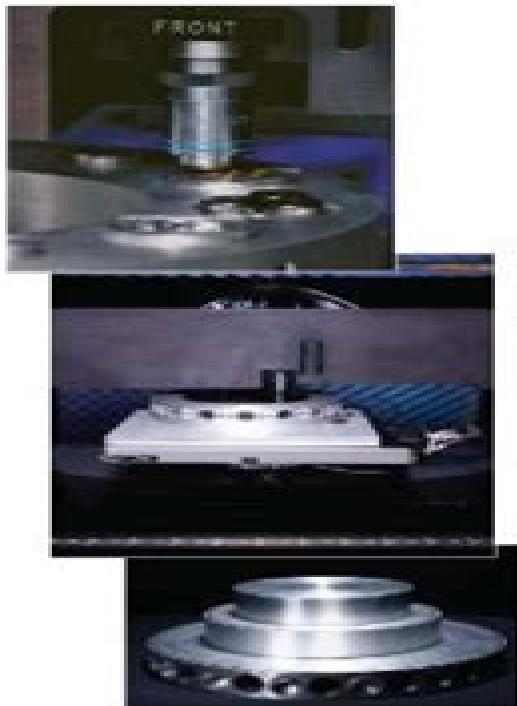


Figure 1. Top: close-up of XP indenter head. Middle: the Nano Indenter G300. Bottom: G300 vacuum chuck stage.

Features and Benefits

- Newly integrated tool simplifies determination of indenter area function and load-frame stiffness
- Accurate, repeatable results compliant with ISO 14577 standard
- Large sample stage supports test specimens with diameters up to 300 mm
- Full testing automation enables nanoindentation instrument to run unattended
- Electromagnetic actuation allows unparalleled dynamic range in force and displacement
- Flexible, upgradable instrument can be configured for repeatable specific applications or a variety of new applications
- Dynamic properties characterization via continuous measurement of stiffness by indentation depth
- Outstanding software with real-time experimental control, easy test protocol development, and precision drift compensation

Applications

- Semiconductor, thin films, MEMS (wafer applications)
- Hard coatings, DLC films
- Composite materials, fibers, polymers
- Metals, ceramics
- Biomaterials, biology

Overview

The Agilent Nano Indenter G300 utilizes a large sample stage that supports test specimens with diameters up to 300 mm. An excellent investment for industrial users, this versatile nanoindentation instrument provides a fast, reliable method to acquire mechanical data on uncut silicon wafers. The G300 permits testing of multiple layers, facilitating product development and failure analysis, while keeping wafers intact for further tests.

Electromagnetic actuation allows the Nano Indenter G300 to achieve unparalleled dynamic range in force and displacement. The G300 enables measurement of Young's modulus and hardness in compliance with ISO 14577. It also enables measurement of deformation over six orders of magnitude (from nanometers to millimeters). Mechanical properties at this scale such as hardness, modulus of elasticity, and fracture behavior can have a significant effect on yield, performance, and longevity of semiconductor devices.

A variety of options can be added to the Nano Indenter G300 to accommodate testing needs such as frequency-specific testing, quantitative scratch and wear testing, integrated probe-based imaging, expanded load capacity up to 10 N, and customizable test protocols.

With the Nano Indenter G300, users are able to quantify the relationship between structure, properties, and performance of their materials quickly and easily with minimal



Agilent Technologies

Agilent Nano Indenter G

**Ivan Dimov, István Faragó, Lubin
Vulkov**

Agilent Nano Indenter G:

Manufacturing and Industrial Engineering Pankaj Agarwal,Lokesh Bajpai,Chandra Pal Singh,Kapil Gupta,J. Paulo Davim,2021-09-28 In terms of pioneering and latest technologies present day advancements in manufacturing and industrial engineering are required to attend to the accelerated and simultaneous demands of high quality productivity and sustainability This book fulfils the aforementioned obligations by offering unique comprehensive chapters on amelioration in manufacturing and industrial engineering technologies with an emphasis on Industry 4.0 This book sheds light on progress in the field of manufacturing and industrial engineering in terms of enhancement in productivity quality and sustainability It exhaustively covers the recent developments latest trends research and innovations that are currently being carried out Furthermore this title discusses 3D printing green manufacturing computer integrated manufacturing cloud manufacturing intelligent condition monitoring advanced forming automation supply chain optimization and advanced manufacturing of composites This book also presents Industry 4.0 based technologies for mechanical and industrial engineering with both a theoretical and a practical focus Manufacturing and Industrial Engineering Theoretical and Advanced Technologies is written for students researchers professors and engineers working in the fields of manufacturing industrial engineering materials science and mechanical engineering *Siloxane-Based Polymers* Ignazio Blanco,2019-07-11 This book a collection of 12 original contributions and 4 reviews provides a selection of the most recent advances in the preparation characterization and applications of polymeric nanocomposites comprising nanoparticles The concept of nanoparticle reinforced polymers came about three decades ago following the outstanding discovery of fullerenes and carbon nanotubes One of the main ideas behind this approach is to improve the matrix mechanical performance The nanoparticles exhibit higher specific surface area surface energy and density compared to microparticles and hence lower nanofiller concentrations are needed to attain properties comparable to or even better than those obtained by conventional microfiller loadings which facilitates processing and minimizes the increase in composite weight The addition of nanoparticles into different polymer matrices opens up an important research area in the field of composite materials Moreover many different types of inorganic nanoparticles such as quantum dots metal oxides and ceramic and metallic nanoparticles have been incorporated into polymers for their application in a wide range of fields ranging from medicine to photovoltaics packaging and structural applications

[Numerical Analysis and Its Applications](#) Ivan Dimov,István Faragó,Lubin Vulkov,2013-10-01 This book constitutes thoroughly revised selected papers of the 5th International Conference on Numerical Analysis and Its Applications NAA 2012 held in Lozenetz Bulgaria in June 2012 The 65 revised papers presented were carefully reviewed and selected from various submissions The papers cover a broad area of topics of interest such as numerical approximation and computational geometry numerical linear algebra and numerical solution of transcendental equation numerical methods for differential equations numerical stochastics numerical modeling and high performance scientific computing **Advanced Material**

Engineering - Proceedings Of The 2015 International Conference Yongchang Liu,Yingquan Peng,2015-09-08 This book represents a collection of papers presented at the 2015 International Conference on Advanced Material Engineering AME 2015 held in Guangzhou China With the rapid development of industry and information technology researchers across all fields began to discuss new ideas related to materials science and manufacturing technology This proceedings provide a valuable insight from researchers and scientists who exchanged their ideas in the conference **Magnesium Technology 2013** Norbert Hort,Suveen Mathaudhu,Neale Neelameggham,Martyn Alderman,2016-12-09 The Magnesium Technology Symposium the event on which this volume is based is one of the largest yearly gatherings of magnesium experts in the world Papers reflect all aspects of the field including primary production to applications recycling basic research findings and industrialization Readers will find broad coverage of current topics including alloys and their properties cast products and processing wrought products and processing corrosion and surface finishing ecology and more New and emerging applications in such areas as hydrogen storage are also examined **Hybrids Part A: Hybrids for Tissue Regeneration** Kai Zheng,Jonathan Lao,Antonio Jesus Salinas,2021-10-01 **Mechanics of Biological Systems and Materials, Volume 7** Francois Barthelat,Chad Korach,Pablo Zavattieri,Barton C. Prorok,K. Jane Grande-Allen,2014-07-28 Mechanics of Biological Systems and Materials Volume 7 Proceedings of the 2014 Annual Conference on Experimental and Applied Mechanics the seventh volume of eight from the Conference brings together contributions to this important area of research and engineering The collection presents early findings and case studies on a wide range of areas including Soft Tissues Mechanics Natural Materials Bio Inspiration Tissue Engineering Cells Mechanics **Development of a Single-stage Nano Indenter** Allen Gabriel Charles Fernandes,2018 **Nanoindentation** Anthony C. Fischer-Cripps,2013-03-09 Mechanical engineering an engineering discipline forged and shaped by the needs of the industrial revolution is once again asked to do its substantial share in the call for industrial renewal The general call is urgent as we face profound issues of productivity and competitiveness that require engineering solutions The Mechanical Engineering Series features graduate texts and research mono graphs intended to address the need for information in contemporary areas of mechanical engineering The series is conceived as a comprehensive one that covers a broad range of concentrations important to mechanical engineering graduate education and research We are fortunate to have a distinguished roster of consulting editors on the advisory board each an expert in one of the areas of concentration The names of the consulting editors are listed on the facing page of this volume The areas of concentration are applied mechanics biomechanics computational mechanics dynamic systems and control energetics mechanics of materials processing production systems thermal science and tribology **Understanding the Deformation Behavior of Lithiated Silicon and Related Advances in Nanoindentation** Lucas Alexander Berla,2014 In the first part of this dissertation silicon micropillar lithiation delithiation studies were employed to assess the robustness of amorphous silicon relative to crystalline silicon to lithiation and delithiation induced fracture Even the largest pillars showed

no lithiation induced interior or exterior cohesive fracture Delithiation of fully lithiated pillars produced internal cohesive fracture initiated by delamination of the pillar substrate interface at the base of the pillar sidewall Finite element modeling indicating concentrated triaxial tensile stresses that move inward and upward with progression of delithiation provided explanation for the observed fracture evolution The research findings demonstrate that amorphous silicon is quite robust to fracture during lithiation the critical size for fracture of amorphous silicon particles upon lithiation is determined to exceed 2 3 μ m The second part of this dissertation is focused on nanoindentation based lithiated silicon deformation behavior studies Prior to indenting lithiated silicon films advances to general nanoindentation techniques were proposed A new physically based function for nanoindentation indenter tip shape calibration was developed The function which accounts for the rounded shape at the indenter tip as well as the pyramidal shape away from the tip fits calibration data well and returns physically meaningful calibration constants Next modifications to the Agilent Technologies Nanoindenter XP stage were implemented to make possible nanoindentation studies of blistered lithiated silicon films immersed in paraffin oil Lithium silicon alloy films of various compositions were probed Young's modulus and the hardness were found to decrease as lithium content increased Indentation creep testing was executed on unlithiated amorphous silicon and heavily lithiated silicon and the results indicate that lithiated silicon creeps readily compared to unlithiated silicon In all cases the viscoplastic flow behavior of lithiated silicon is consistent with power law creep with a large stress exponent 20 Interpreting the measured large stress exponents with a model for thermally activated shear driven local atomic rearrangement the activation volume for the transformation is found to be comparable to the volume of a molecular unit of Li₁₅Si₄ *Applied Nanoindentation in Advanced Materials* Atul Tiwari, Sridhar Natarajan, 2017-10-30 Research in the area of nanoindentation has gained significant momentum in recent years but there are very few books currently available which can educate researchers on the application aspects of this technique in various areas of materials science Applied Nanoindentation in Advanced Materials addresses this need and is a comprehensive self contained reference covering applied aspects of nanoindentation in advanced materials With contributions from leading researchers in the field this book is divided into three parts Part one covers innovations and analysis and parts two and three examine the application and evaluation of soft and ceramic like materials respectively Key features A one stop solution for scholars and researchers to learn applied aspects of nanoindentation Contains contributions from leading researchers in the field Includes the analysis of key properties that can be studied using the nanoindentation technique Covers recent innovations Includes worked examples Applied Nanoindentation in Advanced Materials is an ideal reference for researchers and practitioners working in the areas of nanotechnology and nanomechanics and is also a useful source of information for graduate students in mechanical and materials engineering and chemistry This book also contains a wealth of information for scientists and engineers interested in mathematical modelling and simulations related to nanoindentation testing and analysis **Handbook of Nanoindentation** Michelle L. Oyen, 2019-04-01 Nanoindentation is

ideal for the characterization of inhomogeneous biological materials. However, the use of nanoindentation techniques in biological systems is associated with some distinctively different techniques and challenges. The book presents the basic science of nanoindentation including the background of contact mechanics underlying indentation technique and the instrumentation used to gather mechanical data. It provides perspectives that are optimized for biological applications including discussions on hydrated materials and adaptations for low stiffness materials. The book also covers the applications of nanoindentation technique in biological materials. Highlighting current challenges, it concludes with an insightful forecast of the future. Residual Stresses and Nanoindentation Testing of Films and Coatings Haidou Wang, Lina Zhu, Binshi Xu, 2018-03-12. This book covers the basic principles and application of nanoindentation technology to determine residual stresses in films and coatings. It briefly introduces various detection technologies for measuring residual stresses while mainly focusing on nanoindentation. Subsequently, nanoindentation is used to determine residual stresses in different types of films and coatings and to describe them in detail. This book is intended for specialists, engineers, and graduate students in mechanical design, manufacturing, maintenance, and remanufacturing, and as a guide to the practice of production with social and economic benefits.

Nanoindentation of Natural Materials Arjun Dey, Anoop Kumar Mukhopadhyay, 2018-09-03

Nanoindentation of Natural Materials: Hierarchical and Functionally Graded Microstructures provides a systematic introduction and review of state of the art statistical hierarchical and functionally graded structures found in bone, teeth, hair, and scales from a nanoindentation perspective including detailed microstructure and composition. It covers the basics of hierarchical and functionally graded structures and nanoindentation techniques and detailed discussion with correlation of micro/nano mechanical structures. The book includes practical issues backed with experimental data.

The IBIS Handbook of Nanoindentation Anthony C. Fischer-Cripps, 2005

Nanoindentation of Brittle Solids Arjun Dey, Anoop Kumar

Mukhopadhyay, 2014-06-25. Understanding the Basics of Nanoindentation and Why It Is Important. Contact damage induced brittle fracture is a common problem in the field of brittle solids. In the case of both glass and ceramics and as it relates to both natural and artificial bio materials, it has triggered the need for improved fabrication technology and new product development in the industry. The Nanoindentation Technique Is Especially Dedicated to Brittle Materials. Nanoindentation of Brittle Solids highlights the science and technology of nanoindentation related to brittle materials and considers the applicability of the nanoindentation technique. This book provides a thorough understanding of basic contact induced deformation mechanisms, damage initiation and growth mechanisms. Starting from the basics of contact mechanics and nanoindentation, it considers contact mechanics, addresses contact issues in brittle solids and explores the concepts of hardness and elastic modulus of a material. It examines a variety of brittle solids and deciphers the physics of deformation and fracture at scale lengths compatible with the microstructural unit block. Discusses nanoindentation data analysis methods and various nanoindentation techniques. Includes nanoindentation results from the authors recent research on

natural biomaterials like tooth bone and fish scale materials Considers the nanoindentation response if contact is made too quickly in glass Explores energy issues related to the nanoindentation of glass Describes the nanoindentation response of a coarse grain alumina Examines nanoindentation on microplasma sprayed hydroxyapatite coatings Nanoindentation of Brittle Solids provides a brief history of indentation and explores the science and technology of nanoindentation related to brittle materials It also offers an in depth discussion of indentation size effect the evolution of shear induced deformation during indentation and scratches and includes a collection of related research works

Micromechanical Ink and Printing of Nano-objects Using a Nanoindenter and Electromechanical Testing of Nanomaterial Films Evelyn M. Doherty,2012

A New Instrument for Nanoindentation Edward Roderick Coley,2000 ABSTRACT This thesis presents the design manufacture and evaluation of a nanoindentation instrument for the purpose of investigating nanoscale hardness Nanoscale hardness is the increased hardness observed at indentation depths of approximately 500 nanometers or less Specifically this instrument has been designed to make indents measure penetration depth and determine the force applied in making the indent This project presents a novel nanoindenter design which separates the force and measurement loops to increase accuracy and improve instrument response Both force and displacement sensors utilize capacitance gauging and a transformer ratio bridge coupled with a lock in amplifier A piezoelectric stack provides penetration motion under control from a personal computer Discussion of each component's design parameters merits and limitations are presented With current settings the displacement sensor has a useful resolution of 1 nm and a range of 3 micrometers The force gauge capacitor has a useful minimum resolution of 0.9 nm and range of 1.4 micrometers which yields a force sensor resolution range of 70 micrometers N to 140 mN although adjustments yield a maximum force of over 400 mN if needed Indentations of varying depths ranging from 500 nm to 20 nm were performed on a sample of silicon nitride Hardness values were determined to be 20.3 GPa on average which corresponds to an accepted value for Silicon Nitride of 16 GPa

Handbook of Nanoindentation Michelle L.

Oyen,2010-10-31 Nanoindentation is ideal for the characterization of inhomogeneous biological materials However the use of nanoindentation techniques in biological systems is associated with some distinctively different techniques and challenges The book presents the basic science of nanoindentation including the background of contact mechanics underlying indentation technique and the instrumentation used to gather mechanical data It provides perspectives that are optimized for biological applications including discussions on hydrated materials and adaptations for low stiffness materials The book also covers the applications of nanoindentation technique in biological materials Highlighting current challenges it concludes with an insightful forecast of the future

Tribological Behaviour of Anodised Alumina Nanohoneycombs Professor Shuo Wang,2017-01-26 This dissertation Tribological Behaviour of Anodised Alumina Nanohoneycombs by Shuo Wang was obtained from The University of Hong Kong Pokfulam Hong Kong and is being sold pursuant to Creative Commons Attribution 3.0 Hong Kong License The content of this dissertation has not been altered in any way We have altered the

formatting in order to facilitate the ease of printing and reading of the dissertation All rights not granted by the above license are retained by the author Abstract Anodic alumina nanohoneycombs AAO have been widely used because of its convenient fabrication and controllable pores geometry A lot of investigations have been conducted to study its physical and chemical properties However the mechanical properties especially tribological properties of such a popular nanomaterial still remain almost unknown In this project a series of scratch experiments were conducted on AAO films fabricated by a two step anodisation method The testing system is a G200 Nanoindenter provided by Agilent Corporation A standard diamond Berkovich tip is used as the scratch tip A scanning electron microscope was used to image the microstructure of the material deformation after scratching Strengths of AAO domains with different pore regularities were compared by performing the scratch tests at constant normal loads crossing the boundaries separating these domains Ramping load tests were carried out to show the effects of the normal load on the deformation and friction of the AAO Scratch cycles and velocities were also varied to see their influence on friction and wear The results show that the more ordered AAO structure has higher strength than disordered counterparts under scratch testing The friction coefficient reduces rapidly on increasing normal load and an explanation of this unusual behaviour is offered by considering the row by row deformation of the AAO structure In multicycle scratch tests the friction reaches a maximum at the fourth cycle A step like deformation behaviour was observed when the scratch velocity became extremely large and this is probably due to the dynamic response of the instrument DOI 10 5353 th_b4961813 Subjects Nanostructured materials Mechanical properties Aluminum Anodic oxidation

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