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Materials at High Strain Rates **Constitutive Relation in High/Very High Strain Rates** Metallurgical Effects at High Strain Rates *High Strain Rate Behavior of Nanocomposites and Nanocoatings* **Shock Wave and High-Strain-Rate Phenomena in Materials** **Fundamental Issues and Applications of Shock-Wave and High-Strain-Rate Phenomena** Shock Waves and High-Strain-Rate Phenomena in Metals Effects of Moderately High Strain Rates on the Tensile Properties of Metals High-strain, High-strain-rate Deformation of Tantalum **Metallurgical Effects at High Strain Rates** *An Experimental Study of Aluminum at High Strain Rates and Elevated Temperatures* Stress-strain Characteristics of Materials at High Strain Rates **High Strain Rate Induced Failure in Steels at High Shear Strains** COMPRESSION BEHAVIOR AT HIGH STRAIN RATE FOR AN ULTRA HIGH PERFORMANCE CONCRETE **Mechanical Behavior of Metals at Extremely High Strain Rates** *Analysis of the Strain-rate Sensitivity at High Strain Rates in FCC and BCC Metals* *Stress-Strain Characteristics of Materials at High Strain Rates. Part Iv. Experimental and Theoretical Analysis of Plastic Impacts on Short Cylinders* Stress-strain Characteristics of Materials at High Strain Rates. Part II. Experimental Results High Strain Rate-induced Failure in Steels at High Shear Strains **The Deformation of IN-100 at High Temperatures and High Strain Rates** *Stress-strain Characteristics of Materials at High Strain Rates* Modeling of highstrainrate deformation, fracture, and impact behavior of advanced gas turbine engine materials at low and elevated temperatures **High Strain Rate Effects for Composite Materials** **Stress-strain Characteristics of Materials at High Strain Rates** **Stress-strain characteristics of metals at high strain rates** **Stress-strain Characteristics of Materials at High Strain Rates: Experimental results** **Study of High Strain Rate Response of Composites** **Stress-strain characteristics of materials at high strain rates** *Plastic Deformation of Metals at High Strain Rates. Part I. The Effects of Temperature on the Static and Dynamic Stress-Strain Characteristics in Torsion of 1100-0 Aluminum* **Effects of High Strain Rates and Rapid Heating on the Tensile Properties of Titanium Alloys** ????? ??????? ??? ????? ????-???? **High Strain-Rate and Temperature Effects on the Response of Composites** **Stress-strain Characteristics of Materials at High Strain Rates** **Material Behaviour at High Strain Rates** **Study of Deformation at High Strain Rates Using High-speed Motion Pictures** **Stress-strain Relationship of Concrete at High Strain Rates** Mélanges, publ. à l'occasion du 25me anniversaire de la fondation de la Société auxilaire du Musée de Genève **The High Strain Rate Deformation of Tungsten Single Crystals** *Stress-strain Characteristics of Materials at High Strain Rates: Further studies of dynamic compressive yield stress* *The Constitutive Behavior of Copper at High Strain Rate Determined by the Free Expansion Ring Test*

The Deformation of IN-100 at High Temperatures and High Strain Rates Sep 11 2021

Metallurgical Effects at High Strain Rates Feb 26 2023 A conference on Metallurgical Effects at High Strain Rates was held at Albuquerque, New Mexico, February 5 through 8, 1973, under joint sponsorship of Sandia Laboratories and the Physical Metallurgy Committee of The Metallurgical Society of AIME. This book presents the written proceedings of the meeting. The purpose of the conference was to gather scientists from diverse disciplines and stimulate interdisciplinary discussions on key areas of materials response at high strain rates. In this spirit, it was similar to one of the first highly successful con ferences on this subject held in 1960, in Estes Park, Colorado, on The Response of Metals to High Velocity Deformation. The 1973 conference was able to demonstrate rather directly the increased understanding of high strain rate effects in metals that has evolved over a period of roughly 12 years. In keeping with the interdisciplinary nature of the meeting, the first day was devoted to a tutorial session of invited papers to provide attendees of diverse backgrounds with a common basis of understanding. Sessions were then held with themes centered around key areas of the high strain rate behavior of metals.

Effects of High Strain Rates and Rapid Heating on the Tensile Properties of Titanium Alloys Nov 01 2020

High Strain-Rate and Temperature Effects on the Response of Composites Aug 30 2020 The objective of the research is to expand the experimental study of the effect of strain rate on mechanical response (deformation and failure) of epoxy resins and carbon fibers/epoxy matrix composites, to include elevated temperature tests. The experimental data provide the information needed for NASA scientists for the development of a nonlinear, strain rate and temperature dependent deformation and strength models for composites that can subsequently be used in design. This year effort was directed into the development and testing of the epoxy resin at elevated temperatures. Two types of epoxy resins were tested in shear at high strain rates of about 700 per second and elevated temperatures of 50 and 80 C. The results show that the temperature significantly affects the response of epoxy. Gilat, Amos Glenn Research Center

Materials at High Strain Rates Apr 30 2023

Stress-strain Characteristics of Materials at High Strain Rates. Part II. Experimental Results Nov 13 2021 These two reports were issued separately, but are cataloged as a unit. A photoelectric method for measuring displacements during high-velocity impacts is described. The theory of the system is discussed in detail, and a prototype system which was built and tested is described. The performance of the prototype system is evaluated by comparing the results which it gives with results obtained by other methods of measurement. The system was found capable of a resolution of at least 0.01 inches. static and dynamic stress-strain characteristics of seven high polymers, polyethylene, teflon, nylon, tenite M, tenite H,

polystyrene, and saran, plus three metals, lead, copper, and aluminum, are described and compared by means of stress-strain curves and photographs. Data are also presented which show qualitatively the effects produced on stress-strain characteristics by specimen configuration, temperature, and impact velocity. It is shown that there is a definite strain-rate effect for all these materials except polystyrene. The effect is one of an apparent stiffening of the material with increasing strain rate, which is similar to the effect produced by lowering the temperature. The stress-strain measurements are examined critically, inconsistencies are pointed out, and possible sources of error suggested. Values of yield stress, modulus of elasticity and energy absorption for all materials (except copper and aluminum), specimen configurations, temperatures, and impact velocities included in the investigation are tabulated.

Shock Waves and High-Strain-Rate Phenomena in Metals Oct 25 2022 The scientific understanding of high-velocity deformation has advanced substantially during the past decade. On the one hand, the framework for a theory explaining the metallurgical effects of shock waves is beginning to take shape; on the other hand, the technological applications of high strain-rate processes have found their way into industries in countries around the world. Ex plosive cladding, welding, forming, compaction and consolidation, cutting, and hardening, in addition to high energy-rate deformation processes using other energy sources, are some of the topics of contemporary technological importance. Metallurgical effects are of the utmost importance in both the scientific understanding of the phenomena involved, and in the successful development and utilization of the associated applications. The international conference upon which this book is based had as its major objectives the acceleration of progress in the field of high-strain rate deformation and fabrication, including applications, by providing a forum for the exchange of state-of-the art information on the metallurgical effects of high strain-rate deformation and fabrication; and the organization of this informa tion into a timely and coherent body of knowledge focused around significant areas and applications. This volume is a manifestation of these objectives. In addition, the contents of this book were organized to provide for a somewhat logical perspective of the fundamentals, development, and state-of-the-art applications of high strain-rate and shock phenomena.

An Experimental Study of Aluminum at High Strain Rates and Elevated Temperatures Jun 20 2022

Mechanical Behavior of Metals at Extremely High Strain Rates Feb 14 2022

Stress-strain Characteristics of Materials at High Strain Rates May 08 2021

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Shock Wave and High-Strain-Rate Phenomena in Materials Dec 27 2022 These proceedings of EXPLOMET 90, the International Conference on the Materials Effects of Shock-Wave and High-Strain-Rate Phenomena, held August 1990, in La Jolla, California, represent a global and up-to-date appraisal of this field. Contributions (more than 100) deal with high-strain-rate deforma

Stress-Strain Characteristics of Materials at High Strain Rates. Part Iv. Experimental and Theoretical Analysis of Plastic Impacts on Short Cylinders Dec 15 2021 The effects of strain rate on the stress-strain characteristics of copper and lead were studied by measuring both stress and strain as functions of time using short cylindrical specimens supported at one end on a modified Hopkinson pressure bar and impacted at the other end by a steel projectile. Corresponding stresses and strains were computed according to an elementary nonstrain-rate theory (sometimes referred to as the von Karman theory) in which the dynamic stress-strain curve is assumed to be the same as the static stress- strain curve. Stresses and strains were also computed according to an elementary strain-rate theory (sometimes referred to as the Malvern theory) in which the dynamic stress may exceed the static stress for a given strain by an amount which depends upon the strain rate. It was found that the predictions of the nonstrain- rate theory agreed with measured values only for low impact velocities and for points at least two diameters from the impact end of the specimen. By proper choice of the flow or relaxation constant in the elementary strain-rate theory, measured and computed values of strain, or of stress, but not both simultaneously, could be brought into agreement. In the more general exponentialtype, strain-rate law, two independent parameters appear. Presumably with two constants to adjust, this theory could be made to correctly predict both stresses and strains for the conditions under which the tests were performed. If this procedure forces the theory to account for variations which are actually caused by lateral inertia and shear, erroneous conclusions regarding the properties of the material will be drawn. Further study of the effects of shear and lateral inentia is indicated. (auth).

Stress-strain Characteristics of Materials at High Strain Rates: Experimental results Mar 06 2021

Study of Deformation at High Strain Rates Using High-speed Motion Pictures May 27 2020

High Strain Rate Behavior of Nanocomposites and Nanocoatings Jan 28 2023 This book describes the use of multiwall carbon nanotubes as composites with polycarbonates and as protective coatings on glass surfaces. The book explains fabrication and characterization methods for these composites and coatings. The author reports on the use of Split Hopkinson Pressure Bar set up for evaluating the dynamic strength of these composites and coatings and studying the role of carbon nanotubes in the enhancement of their dynamic strength.

Fundamental Issues and Applications of Shock-Wave and High-Strain-Rate Phenomena Nov 25 2022 This book contains the proceedings of EXPLOMETTM 2000, International Conference on Fundamental Issues and Applications of Shock-Wave and High-Strain-Rate Phenomena, held in Albuquerque, New Mexico, 2000; the fifth in the EXPLOMETTM quinquennial series which began in Albuquerque in 1980. The book is divided into five major sections with a total of 85 chapters. Section I deals with materials issues in shock and high strain rates while Section II covers shock consolidation, reactions, and synthesis. Materials aspects of ballistic and hypervelocity impact are covered in Section III followed by modeling and simulation in Section IV and a range of novel applications of shock and high-strain-rate phenomena in Section V. Like previous conference volumes published in 1980, 1985, and 1995, the current volume includes contributions from fourteen countries outside the United States. As a consequence, it is hoped that this book will serve as a global summary of current issues involving shock and high-strain-rate phenomena as well as a general reference and teaching

componant for specializd curricula dealing with these features in a contemporary way. Over the past twenty years, the EXPLOMETTM Conferences have created a family of participants who not only converse every five years but who have developed long-standing interactions and professional relationships which continue to stimulate new concepts and applications particularly rooted in basic materials behavior.

Study of High Strain Rate Response of Composites Feb 02 2021 The objective of the research was to continue the experimental study of the effect of strain rate on mechanical response (deformation and failure) of epoxy resins and carbon fibers/epoxy matrix composites, and to initiate a study of the effects of temperature by developing an elevated temperature test. The experimental data provide the information needed for NASA scientists for the development of a nonlinear, rate dependent deformation and strength models for composites that can subsequently be used in design. This year effort was directed into testing the epoxy resin. Three types of epoxy resins were tested in tension and shear at various strain rates that ranges from 5 x 10(exp -5), to 1000 per second. Pilot shear experiments were done at high strain rate and an elevated temperature of 80 C. The results show that all, the strain rate, the mode of loading, and temperature significantly affect the response of epoxy.Gilat, AmosGlenn Research CenterSTRAIN RATE; EPOXY MATRIX COMPOSITES; EPOXY RESINS; MECHANICAL PROPERTIES; TORSIONAL STRESS; DEFORMATION; SHEAR STRAIN; NONLINEARITY; HIGH TEMPERATURE TESTS; STRESS-STRAIN DIAGRAMS; TENSILE TESTS; STRUCTURAL FAILURE

Effects of Moderately High Strain Rates on the Tensile Properties of Metals Sep 23 2022 Typical effects of increasing the strain rate to nearly 100 in./in./ min at room and elevated temperatures on the tensile properties of a number of commercial alloys are discussed. A bibliography is included of information on specific effects of moderately high strain rates on these AND OTHER ALLOYS. Plots of typical data for a number of commercial alloys illustrate the following general trends resulting from increasing the strain rate: at room temperature, the yield and ultimate tensile strengths of a given alloy either are not affected or are increased slightly as the strain rate is increased; at slightly elevated temperatures, the effect of increasing the strain rate is generally similar to that at room temperature, if the alloy has negligible tendency to creep at stresses lower than the yield strength and remains in a stable condition; and at high temperatures, increasing the strain rate causes substantial increases in the yield and ultimate strengths, if the alloy tends to creep at stresses lower than the yield strength.

Stress-strain Relationship of Concrete at High Strain Rates Apr 26 2020

Stress-strain Characteristics of Materials at High Strain Rates May 20 2022

COMPRESSION BEHAVIOR AT HIGH STRAIN RATE FOR AN ULTRA HIGH PERFORMANCE CONCRETE Mar 18 2022 Abstract : The need for a stronger and more durable building material is becoming more important as the structural engineering field expands and challenges the behavioral limits of current materials. One of the demands for stronger material is rooted in the effects that dynamic loading has on a structure. High strain rates on the order of 101 s-1 to 103 s-1, though a small part of the overall types of loading that occur anywhere between 10-8 s-1 to 104 s-1 and at any point in a structures life, have very important effects when considering dynamic loading on a structure. High strain rates such as these can cause the material and structure to behave differently than at slower strain rates, which necessitates the need for the testing of materials under such loading to understand its behavior. Ultra high performance concrete (UHPC), a relatively new material in the U.S. construction industry, exhibits many enhanced strength and durability properties compared to the standard normal strength concrete. However, the use of this material for high strain rate applications requires an understanding of UHPC's dynamic properties under corresponding loads. One such dynamic property is the increase in compressive strength under high strain rate load conditions, quantified as the dynamic increase factor (DIF). This factor allows a designer to relate the dynamic compressive strength back to the static compressive strength, which generally is a well-established property. Previous research establishes the relationships for the concept of DIF in design. The generally accepted methodology for obtaining high strain rates to study the enhanced behavior of compressive material strength is the split Hopkinson pressure bar (SHPB). In this research, 83 Cor-Tuf UHPC specimens were tested in dynamic compression using a SHPB at Michigan Technological University. The specimens were separated into two categories: ambient cured and thermally treated, with aspect ratios of 0.5:1, 1:1, and 2:1 within each category. There was statistically no significant difference in mean DIF for the aspect ratios and cure regimes that were considered in this study. DIF's ranged from 1.85 to 2.09. Failure modes were observed to be mostly Type 2, Type 4, or combinations thereof for all specimen aspect ratios when classified according to ASTM C39 fracture pattern guidelines. The Comite Euro-International du Beton (CEB) model for DIF versus strain rate does not accurately predict the DIF for UHPC data gathered in this study. Additionally, a measurement system analysis was conducted to observe variance within the measurement system and a general linear model analysis was performed to examine the interaction and main effects that aspect ratio, cannon pressure, and cure method have on the maximum dynamic stress.

Modeling of highstrainrate deformation, fracture, and impact behavior of advanced gas turbine engine materials at low and elevated temperatures Jul 10 2021

Stress-strain characteristics of materials at high strain rates Jan 04 2021

High Strain Rate Effects for Composite Materials Jun 08 2021 We have been developing the capability to characterize the high strain rate response of continuous fiber polymer composites. The data presented cover strain rates from 0/s to 3000/s. A combination of test machines and specimen geometries was investigated. Strain rates from 0 to 100/s were generated using conventional and high-speed hydraulic test machines. Strain rates from 10 to 1000/s were generated using a high-energy drop tower, and rates from 1000 to 3000/s were generated using a split Hopkinson bar. Strain rates above 100/s have only been generated for uniaxial compression. Our efforts have primarily focused on developing the high-energy drop tower for these purposes. Specimen geometries for compression include tapered cubes, one-inch tubes, and solid rods. For tension, a smaller 1.27-cm-diameter version of our 5.08-cm-diameter multiaxial test specimen was

developed and has been successfully used at strain rates up to 100 per second. Fixtures were also developed for performing high strain rate shear testing and through thickness penetration studies of composite plates. The objective of these experiments is to develop dynamic material models for use in finite element design tools. This presentation will focus on the methods and results obtained from this study.

The High Strain Rate Deformation of Tungsten Single Crystals Feb 23 2020 Samples of single-crystal tungsten, in three orientations (100, 110, 111), were compressively deformed at high strain rates (1,000-2,000 /s) using a Kolsky (split-Hopkinson) type pressure bar apparatus. Samples of the single-crystal tungsten were also deformed at low strain rate (0.0001/ s) using a conventional load frame. The 110 orientation exhibited constraint of flow consistent with twofold crystal symmetry about this axis, resulting in skewed flow and noncylindrical specimens after the Kolsky bar test. Both the 111 and 110 orientations exhibited a yield or load drop phenomenon. This load drop may have been associated with either: (1) lack of screw dislocation cross slip at high strain rate; (2) twinning of the crystal lattice; or (3)interstitial solute atoms such as nitrogen or carbon pinning dislocations. As a result of this load drop for the lower symmetry 111 and 110 orientations, the quasi-static (0.0001/s) test had higher flow stress for a given strain than the higher strain rate tests with the Kolsky bar. The 100 orientation crystals exhibited uniform deformation and high rate of work-hardening at both low and high strain rates. The unique behavior of these crystals is postulated in terms of the crystal symmetry, structural evolution at various strain rates, and dislocation flow mechanisms.

High Strain Rate-induced Failure in Steels at High Shear Strains Oct 13 2021 Materials deformed at high strain rates exhibit sometimes the behaviour that is very different from that at static or quasi-static loading. Material and physical properties that are of no concern in low strain rates become crucial in the material response at high strain rates. Material properties such as thermal diffusivity and thermal softening have to be considered in order to understand the mechanism of deformation at high strain rates. The most important aspect of high strain rate deformation is the occurrence of local thermal and mechanical instability that leads to failure of the material, usually characterised by the occurrence of adiabatic shear bands (ASB). In this study, AISI 4140 steel was tested using a torsional split Hopkinson bar at three different strain rates and the impact of strain rate on the material behaviour was examined. The influence of material hardness on failure mechanisms was also investigated by producing different tempers of 4140 steel with distinct microstructures and different hardness. The fracture surface of specimens was examined under the scanning electron microscope (SEM). (Abstract shortened by UMI.).

High Strain Rate Induced Failure in Steels at High Shear Strains Apr 18 2022

Stress-strain Characteristics of Materials at High Strain Rates Aug 11 2021

Plastic Deformation of Metals at High Strain Rates. Part I. The Effects of Temperature on the Static and Dynamic Stress-Strain Characteristics in Torsion of 1100-0 Aluminum Dec 03 2020 A series of tests is described in which tubular specimens of a commercially pure polycrystalline aluminum were loaded in torsion up to shear strains of about 2 and 4% respectively, over the temperature range -180C to 250C. The experimental results give the flow stress in shear, the strain and the strain rate against time. They also give stress-strain curves which are compared to the corrresponding static curves obtained by testing similar specimens in torsion at about 0.001/sec. A graph showing the dependence of flow stress on temperature indicates that there are three different temperature ranges for polycrystalline aluminum within each of which a different deformation mechanism presumably dominates the flow process. (Modified author abstract).

Stress-strain Characteristics of Materials at High Strain Rates: Further studies of dynamic compressive yield stress Jan 22 2020

Stress-strain characteristics of metals at high strain rates Apr 06 2021

Constitutive Relation in High/Very High Strain Rates Mar 30 2023 The IUTAM Symposium on Constitutive Relation in High/Very High Strain Rates (CRHVHSR) was held October 16 - 19, 1995, at Seminar House, Science University of Tokyo, under the sponsorship of IUTAM, Japan Society for the Promotion of Science, The Commemorative Association for the Japan World Exposition (1970), Inoue Foundation for Science, The Japan Society for Aeronautical and Space Sciences, and Science University of Tokyo. The proposal to hold the symposium was accepted by the General Assembly of IUT AM held in Haifa, Israel, in August 1992, and the scientists mentioned below were appointed by the Bureau of IUTAM to serve as members of the Scientific Committee. The main object of the symposium was to make a general survey of recent developments in the research of constitutive relations in high and very high strain rates and related problems in high velocity solid mechanics, and to explore further new ideas for dealing with unresolved problems of a fundamental nature as well as of practical importance. The subjects covered theoretical, experimental, and numerical fields in the above-mentioned problems in solids, covering metals, polymers, ceramics, and composites. Emphasis was given to the following fields: 1. Material characterization of solids in high velocity deformation, experimental techniques, typical data obtained by these techniques, modeling, and constitutive relations 2. Strain rate dependent elasto-visco-plastic stress waves 3. Crack initiation, propagation, and dynamic fracture toughness 4. Dynamic stress concentration 5. Structural dynamics in impact and constitutive relations of solids 6.

Material Behaviour at High Strain Rates Jun 28 2020

Analysis of the Strain-rate Sensitivity at High Strain Rates in FCC and BCC Metals Jan 16 2022 The development of a constitutive model based on the use of internal state variables and phenomenological models describing glide kinetics is reviewed. Application of the model to the deformation of fcc metals and alloys is illustrated, with an emphasis on the behavior at high strain rates. Preliminary results in pure iron and 4340 steel are also presented. Deformation twinning is observed in iron samples deformed in the Hopkinson pressure bar. The influence of twinning on the proposed constitutive is discussed. 11 refs., 8 figs.

Mélanges, publ. à l'occasion du 25me anniversaire de la fondation de la Société auxilaire du Musée de Genève Mar 25

2020
High-strain, High-strain-rate Deformation of Tantalum Aug 23 2022
The Constitutive Behavior of Copper at High Strain Rate Determined by the Free Expansion Ring Test Dec 23 2019
Abstract: Study of deformation of materials at high strain rate is important to many industries. Several techniques exist to characterize materials at high strain rates but all of them have their limitations. The ring expansion technique is explored in this thesis. This technique can augment the scope of research in this field.
Stress-strain Characteristics of Materials at High Strain Rates Jul 30 2020
Metallurgical Effects at High Strain Rates Jul 22 2022 A conference on Metallurgical Effects at High Strain Rates was held at Albuquerque, New Mexico, February 5 through 8, 1973, under joint sponsorship of Sandia Laboratories and the Physical Metallurgy Committee of The Metallurgical Society of AIME. This book presents the written proceedings of the meeting. The purpose of the conference was to gather scientists from diverse disciplines and stimulate interdisciplinary discussions on key areas of materials response at high strain rates. In this spirit, it was similar to one of the first highly successful con ferences on this subject held in 1960, in Estes Park, Colorado, on The Response of Metals to High Velocity Deformation. The 1973 conference was able to demonstrate rather directly the increased understanding of high strain rate effects in metals that has evolved over a period of roughly 12 years. In keeping with the interdisciplinary nature of the meeting, the first day was devoted to a tutorial session of invited papers to provide attendees of diverse backgrounds with a common basis of understanding. Sessions were then held with themes centered around key areas of the high strain rate behavior of metals.