DSI™
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The Gleeble® NEWSLETTER

Fall 1996

DSI at Expositions and Conferences

Materials Week ’96, October 6–10, Cincinnati, Ohio

DSI will be exhibiting the latest in Gleeble Systems technology at the Materials Exposition, October 6–10, in Cincinnati, Ohio. Come see us at Booth 515 where applications engineers will be available to discuss your testing and simulations requirements.

Materials Week is the largest gathering of materials engineers of the year and is held this year in conjunction with the National Thermal Spray Conference & Expo. Nearly 200 technical sessions will be offered on a variety of materials engineering topics.

ASM INTERNATIONAL®
The Materials Information Society

ISS Mechanical Working & Steel Processing Conference, October 13–16, Cleveland, Ohio

DSI applications engineers will be at the ISS Mechanical Working & Steel Processing Conference. If you are attending the conference, please stop by our display area and see the latest in applications and technology for physical simulation of steel working processes.

For more information on this conference contact the ISS at 412-776-9460.

Gleeble® 1500 Digital Control Update

The Power of Windows Software and Digital Closed-Loop Control is now available for your Gleeble 1500

The same closed-loop digital control system with Pentium computing power and Windows-based software used on the Gleeble 3500 is now available for retrofitting on Gleeble 1500 systems. Upgrading your Gleeble 1500 system can provide your laboratory with the productivity gains achieved through easy-to-use Windows control software, total computer control of test functions, high speed data acquisition, and Windows-based data analysis and plotting software for report-ready data presentations.

The Series 3 Digital Control Update provides all the signals necessary to control thermal and mechanical test variables simultaneously through the digital closed-loop thermal and mechanical servo systems. The Gleeble 1500 with the addition of the Series 3 Update can be operated totally by computer, totally by manual control, or by any combination of computer and manual control needed to provide maximum versatility in materials testing.

The environment for this Series 3 Update of the Gleeble 1500 consists of a Windows-based workstation and powerful embedded processor in a new control console. The Windows workstation offers a flexible industry-standard multi-tasking

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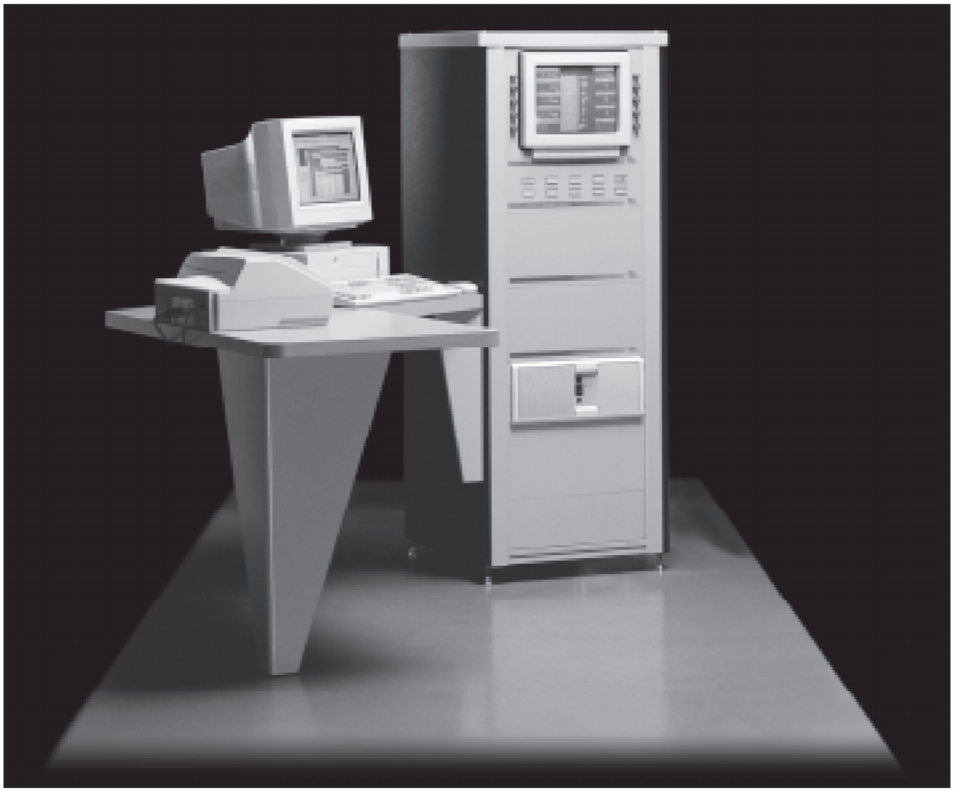

The Gleeble 1500 Digital Control System is shown above with optional computer table.

Recent Gleeble Papers

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HAZ Hot Cracking Behavior of HD 556 and INCONEL 617

by C.D. Lundin, C.Y.P. Qiao, and R.W. Swindeman

The weldability of HD 556 and Inconel 617 alloys was evaluated using the Gleeble Hot Ductility Test and the Varestraint Hot Cracking Test. The results from the metallographic examination indicate that the rare earth element La has a beneficial influence on HAZ liquation cracking resistance and Ti rich carbides or Ti rich carbonitrides enhance the HAZ liquation cracking propensity. A qualitative characterization of the particles in the HAZs was performed. The HAZ liquation cracking tendencies for both materials are addressed from the hot cracking theory standpoint. The correlative criteria are technologically based and are directly related to hot cracking and solidification theory.

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Copper-Precipitation Strengthened HSLA Steels: Designing for Base Plate and HAZ Toughness

by M.R. Krishnadev, W.L. Zhang, and J.T. Bowker

The study deals with the development of an understanding of the relation between the microstructure and toughness of the HAZ and that of the base plate in copper strengthened HSLA steels containing varying levels of manganese (0.5 to 1.3 percent) and nickel (1 to 2.5 percent). To isolate the effect of a copper, a copper free composition has also been used. A Gleeble thermal/mechanical simulator has been used to simulate the coarse grained HAZ region and to determine its transformation kinetics. SEM and TEM have been used to characterize the fracture behavior and microstructure respectively. Instrumented Charpy testing has been used to evaluate crack initiation and propagation behavior. Toughness variations have been related to the variations in the nature of transformation microstructures. Based on the results, guidelines for designing Cu-HSLA steels for achieving good toughness in both the base plate and the HAZ are outlined.

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Progress in Material Properties and Weldability of Modern HSLA Steels

by M. Mayrhofer, H. Schültz, R. Rauch, H. Cerjak, and H. Kammerstetter

A short historical review shows the essential motives which led to the development of thermomechanically processed (TM) high strength low alloy (HSLA) steels. The "state of the art" of TM-steel production has been summarized. The weldability of TM-steels with yield-strengths ranging from 355 MPa up to 690 MPa has been quantified by the investigation of real welded joints and welding simulation technique. In this paper the results of the toughness testing task have been reported. Toughness has been characterized by ISO-V testing. The reported results allow the direct comparison of welding simulation technique with real welded joints. The toughness behaviour of simulated heat affected zone (HAZ) microstructure of TM-steels has been compared to that of equivalent grades of normalized (N) or quenched and tempered (QT) type of steels. The introduction of new technologies mostly presupposes the availability of materials with new specific properties. The reason why steel is of paramount importance in industrial development no doubt lies in the fact that, unlike other materials, it may exhibit a variety of characteristics adjusted to the intended use, and that it is possible, again and again, to find new potentials for further and new developments. The essential motives of development can be summarized as follows: (a) Safety, with special emphasis on behaviour under complex processing stresses and on the structural component; (b) Economic efficiency, including the utilization of high strength, the simple processing in forming and welding; (c) Competitiveness, as compared to alternative materials.

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Augmented Sintering of Steel Powder

by Q. Qiong, J. Allen, G.R. Rogers, and D.W. Walsh

The effects of a thermally cycled sintering process (vis-a-vis an isothermal sintering process) were examined in a low carbon steel powder. Several thermal processes were used, among them (1) an isothermal process similar to traditional methods, (2) a thermally cycled process imposing periodic free cooling from the traditional sintering temperature to a minimum temperature below the lower critical temperature, (3) a low temperature cycled process with a maximum temperature slightly in excess of the upper critical temperature, (4) a thermally cycled process imposing periodic free cooling from the traditional sintering temperature to a minimum temperature slightly in excess of the upper critical temperature, and (5) an isothermal sintering process with a peak temperature slightly in excess of the upper critical temperature. The duration for all tests was one-half hour. Sintering was done under argon in the Gleeble HAZ 1000—a computer-controlled, thermomechanical testing device in which heat is supplied to the specimen by electric resistance heating. The extent of sintering was measured using a quantitative image analysis system. Several parameters were measured and recorded; these included pore area fraction, pore area, maximum linear pore dimension, pore roughness and pore roundness. Thermal cycling appears to accelerate the sintering process, the changing thermal gradient drives diffusion, grain growth, nucleation, recrystallization, and many other processes. Of particular interest is the cyclic grain refinement caused by repeated nucleations during the equilibrium phase transformations.

THERMEC '97 Set for Wollongong, Australia

THERMEC '97, International Conference on Thermomechanical Processing of Steels & Other Materials, will be held July 7–11, 1997, at the University of Wollongong, Australia.

The first international conference on the subject, THERMEC '88, was held in Tokyo, Japan in 1988 and was a resounding success. Today the scientific and practical knowledge has reached a level which, in a number of cases, permits the planned development of materials by suitable thermomechanical processing techniques.

This conference will focus on recent advances in the overall field of science and technology of thermomechanical process (TMP) of steels, including stainless steels, other non-ferrous materials, and especially alloys of Al, Ti, Cu, Mg and Ni. TMP of superalloys, discontinuously reinforced metal/matrix composites, and intermetallics will also be covered.

Special sessions will be devoted to both fundamental investigation and factory-floor issues related to casting of sheet, strip, and slabs, as well as near-net shape casting, including implementation of research findings to solve production problems. Superplastic deformation/forming, diffusion bonding, and advanced superconductors and HTSC materials will have numerous sessions at THERMEC '97.

Topics

Major topics to be covered in the symposium are:

- Deformation behavior during hot and warm working
- Static and dynamic recrystallization, precipitation and grain growth
- Microstructural evolution during and after working
- Interplay of transformation, precipitation and recrystallization, and its application to structure control and improvement of properties
- Thermomechanical rolling and cooling of modern steels such as HSLA, microalloyed, interstitial free and low carbon steels in plate, strip and sheet and steels for long products (bar, rod, sections, rails and shapes)
- TMP of aerospace materials especially alloys of Ti, Al and discontinuously reinforced metallic composites, intermetallics and superalloys
- Strip casting, slab casting, near-net shape casting and related processes
- Superplastic deformation/forming, diffusion bonding in engineering materials
- Modelling of deformation processes and development of expert systems
- Modelling of microstructures and textures
- Advanced superconductors and high temperature superconductors—characterization and microstructures, thin and thick films, wires, tapes and bulk materials, interfaces, grain boundaries, critical current, flux pinning and practical applications

Both invited and contributed presentations will be included.

Topic Coordinators at THERMEC '97

- *Al Alloys & Composites:* H.J. McQueen, E. Evangelista, F. Montheillet, G.M. Raynaud
- *Ti Alloys:* D. Eylon, I. Weiss, S. Fujishiro, T. Nishimura
- *Ni Alloys & Superalloys:* A. Mitchell
- *Superplacticity/BD:* T.G. Langdon, N. Chandra, K. Higashi
- *Modelling of Deformation Processes:* J.H. Beynon, P.D. Hodgson
- *Textures:* G. Gottstein, John J. Jonas
- *Superconductors:* E.W. Collings, S.X. Dou, T. Watanabe, U. Balachandran
- *Steels:* C. Ouchi, T. Sakai, T. Senuma, G. Tither, T. Maki, F. Heisterkamp
- *Strip Casting:* J. Herbertson, T. Chandra

Gleeble® 1500 Digital Control Update

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Graphical User Interface for creating simulation programs and analyzing the resulting data, as well as creating reports and presentations.

In designing the operator interface for the Gleeble 3500, DSI engineers recognized that highly flexible control is essential for machine performance. Thus every aspect of the Series 3 Digital Control System can be controlled via computer and set up in advance in the program. To make the system even more flexible and allow easy, convenient manual control of the system at any time, the Series 3 Update includes a freestanding control console with 10 Virtual Panel Meters (VPMs).

Each of these VPMs includes a control knob and data readout and can be software or manually configured to control whatever part of the system the operator requires. As a result, the operator has total flexibility in manual control of the system, yet sacrifices none of the power and convenience of computer control when that is a better option. Prewritten test programs can be run with no modifications, or, if desired, the VPMs can be used to manually override the computer program while the test is in progress.

The Series 3 Update has a full set of software tools available for both controlling the Gleeble and analyzing the results. The operator can create tests on the workstation through a number of programming options, including QuikSim Software, a spreadsheet-like, fill-in-the-blanks software that describes each action in a test sequence in order and duration. QuikSim allows arbitrary programming of waveforms for both thermal and mechanical systems.

Once a test or simulation has been completed, the results are automatically loaded into Origin software, a powerful and flexible data analysis package included with every Series 3 Update. Origin provides many built-in mathematical functions for analyzing data as well as the LabTalk language which can be used to automate the repetitive analyses tasks typical of a comprehensive simulation or testing program. Origin can be set up to load data from each test and immediately display any number of plots, allowing a quick and easy review of each test. Origin produces colorful, publication-quality graphs and charts.

The Series 3 Update package has been designed to provide maximum performance at a reasonable cost. The package replaces the existing Gleeble 1500 console with a new console containing the embedded computer, the system control panels, all the signal conditioning modules, and the VPM CRT display unit. The existing computer table is attached to the new console, and a new Windows-based Workstation is installed.

To update your Gleeble 1500, contact us at DSI.

7th ISPS Slated for Tsukuba, Japan in January

The 7th International Symposium on Physical Simulation (ISPS) will be held in Tsukuba, Japan, January 21–23, 1997. The ISPS will allow metallurgists, research scientists, product and process development engineers, and managers an opportunity to meet and discuss the latest physical simulation techniques and results as they relate to welding, hot forming, casting, and other thermal/mechanical processes.

More than 40 papers from the USA, Europe, and Asia have already been submitted for this ISPS. Keynote speakers for the 7th ISPS will include:

- Dr. H.S. Ferguson (Director of Research and Development, Dynamic Systems Inc., USA)
- Dr. C.D. Lundin (Professor, University of Tennessee, USA)
- Dr. H.H. Cerjak (Professor, Graz University of Technology, Austria)
- Dr. Z. Dang (Professor, University of Science and Technology, Beijing, China)
- Dr. F. Matsuda (Emeritus Professor of Osaka University, Japan Power Engineering and Inspection Corp.)
- Dr. H.G. Suzuki (Director, National Research Institute for Metals, Japan
- Dr. T. Umeda (Professor, Tokyo University, Japan)
- Dr. J.J. Jonas (Professor, McGill University, Canada)
- Dr. T. Sakai (Professor, University of Electro-Communications, Japan)

Registration Fees

The registration free for a delegate is $200 (or ¥20,000) if received before November 1, 1996.

The registration fee includes:

- Conference documents
- Abstract bulletin
- Conference proceedings
- Welcoming reception
- Morning and afternoon coffee breaks
- Banquet at National Research Institute for Metals

Venue

The 7th ISPS will be held at the National Research Institute for Metals (NRIM) in Tsukuba, Japan.

Tsukuba Science City is located about 50 km northeast from Tokyo, and 40 km northwest of the New Tokyo International Airport (Narita Airport), Japan's gateway to the skies. NRIM is located in southeast Tsukuba, 15 min. walk from Tsukuba Center.

Tsukuba Science City is Japan's representative research and development center, designed both to relieve the congestion of the Tokyo Metropolitan Area and to advance scientific technology. It was created to be a well-balanced garden city by moving research, educational, and other institutions out of Tokyo, and by building an environment suitable for research and educational activities.

7th ISPS Secretariat

For additional information about ISPS, contact:

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Upcoming DSI Papers

TMS, ASM Materials Week
Cincinnati, Ohio, USA
October 6–10, 1996

"High Temperature Fracture Limit of a Material," by W.C. Chen and H.S. Ferguson.

THERMEC '97
Wollongong, Australia
July 7–11, 1997

"High Speed Hot Deformation Process Simulation Using the Hydrawedge System," by W.C. Chen and H.S. Ferguson.

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