DSI

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The Gleeble® NEWSLETTER

Winter 2005–06

See Us at the Shows

Steel Rolling 2006, June 19–21, Paris, France

Steel Rolling 2006 will be held June 19–21, 2006, in Paris, France. The Conference will be held at CNIT, 2 Place de La Defense.

The scope of the conference includes carbon steel, stainless steel, special steel, heavy plates, hot rolling, cold rolling, flat products, and long products such as wire. Technologies and innovations to be covered include modeling, scheduling, simulation, metallurgy, maintenance, environment, management, rolls, measurement and control, tribology, process, energy savings, safety and accident prevention, and product quality.

For more information about Steel Rolling 2006, visit http://www.ats-ffa.org/anglais/

THERMEC' 2006, July 4–8, 2006, Vancouver, Canada

THERMEC' 2006, International Conference on processing and manufacturing of advanced materials will be held July 4–8, 2006, at the Fairmont Hotel, Vancouver, British Columbia. The Conference will cover all aspects of processing, fabrication, structure/property evaluation and applications of both ferrous and non-ferrous materials including hydrogen and fuel cell technologies, metallic glasses, thin films, ecomaterials, nanocrystalline materials, biomaterials and other advanced materials.

For further information, visit http://thermec.uow.edu.au or contact:

Professor T. Chandra
Faculty of Engineering

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Gleeble Application Story

The Gleeble at Utah State University in Logan, Utah

Someday cars may be cleaner and safer, and mankind may be able to see farther than ever before into the depths of the universe, thanks in part to work being conducted on a Gleeble simulation system at Utah State University in Logan, Utah.

Dr. Leijun Li, Assistant Professor of Mechanical and Aerospace Engineering, says, "We use our Gleeble 1500D for whatever a traditional Gleeble is capable of doing—welding, casting, deformation, and various sorts of simulations—but we also use it for some surprising things."

Mostly the Gleeble is used in support of graduate studies and industrial sponsored research, Dr. Li says. "Graduate students and post-docs work on these projects, and it gives them an opportunity for real-world experience."

For example, the Utah State team recently completed a project for NASA on the planned James Webb Space Telescope. "There is a thermal switch that controls the temperature of the structure," Dr. Li says. "NASA wanted to verify whether or not the switch would work properly in the vacuum of space. We studied it on the Gleeble and were able to show that it will work in vacuum."

For the National Science Foundation, Dr. Li and his colleagues have used the Gleeble to investigate the joining of metal matrix composites using ultrasonic welding. "On the Gleeble, we looked at high strain rate plasticity behavior by physically simulating a high-speed loading rate and some pretty high temperatures," Dr.

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Dr. Leijun Li (standing, left) and graduate students prepare tests using the Gleeble 1500D at Utah State University in Logan, Utah.

Recent Gleeble Papers

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High Temperature Deformation Mechanism and Constitutive Equation of Ti-40 Burn Resistant Titanium Alloy

by Y. Zhao, L. Zhou, and J. Deng

Ti-40 alloy is a single ß phase burn resistant titanium alloy. Its high temperature deformation mechanism is studied and its stress-strain ($\sigma - \varepsilon$) curves are examined by use of Gleeble 1500 thermal-simulator. The results reveal that there are abrupt flow stress drops followed by steady state. The magnitude of the flow stress drop increases with strain rate and decreases with temperature. Deformation activation energy, Q, is 247.5 KJ/mol. The deformation mechanism of Ti-40 alloy is controlled by the lattice diffusion. Its constitutive equation is set up, i.e., $\dot{\varepsilon} = e^{-0.994}\ \sigma^{4.65} \exp(-247500/RT)$.

447

Simulation of Weld Thermal Cycle Using the Model of Carbonitride Particles Precipitation

by C.B. Gui, S.H. Yang, Z. Xiong, and J.B. Hong

During welding of steel the thermal pulse experimented in the heat affected zone (HAZ) adjacent to the molten weld bead can result in prominent microstructure changes in steel. Rapid autenite grain growth and the formation of coarse transformation products on cooling may lead to a coarse-grained region of relatively poor toughness that is subject to failure. But carbon-nitride particles can improve very effectively the toughness of the HAZ even at the very high welding heat input because this particle can inhibit the growth of the austenite grains during welding thermal cycling. Thus, it is important to predict the precipitation transformation start temperataure of the particles in welding thermal cycles. In this investigation, based on the classical nuclation theory, the kinetic precitipation model of carbon-nitride particles in weld HAZ is proposed. Using the model, welding simulation technology and the quantitative metallographic analysis, the precititation transformation temperature (PTT) curve is obtained. The data from the simulated welds are in good agreement with the value that the PTT curves predicted.

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Effect of Hot Deformation Parameters on Recrystallization of Steel T91

by F.X. Zhu, C. Liu, G.Z. Chui, and D.F. Gao

In this paper the recrystallization behavior of steel 9Cr-1Mo-V-Nb-N at high temperature was studied using Gleeble 1500 thermalmechanical simulator. The critical conditions of occurrence of dynamic recrystallization during hot deformaiton were obtained, and by means of double hit testing with an inter-hit time, the metadymanic recrystallization between rolling passes and its effect factors were also imitated. Additionally, the deformation activation energy of T91 steel, the relationship between critical stress, strain, temperature, and strain rate, were regressed respectively, the results were satisfied.

438

Applications of Physical Simulation in the Development of Hot Working Processes

by L.P. Karjalainen

Modelling has become a more and more valuable tool in the design, control and development of steel processing. Empirical regression equations, physically based approaches, artificial neural networks and hybrid models are being adopted in computer modelling. In all cases, relevant data are necessary, which can be most economically obtained by physical simulation. Physical simulation with a Gleeble simulator has been used in a large number of tasks at the University of Oulu for ten years in cooperation with the Finnish metals industry. Some examples of these will be described and discussed below, such as the optimization of the recrystallization controlled rolling process, the improvement of the hot strength model for the control of coiling tension, and the optimization of continuous strip annealing schedules. Finally, brief remarks will be given on a couple of projects now underway.

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Effects of Diffusion Welding Parameteres on Joint Strength of SiCw/6061Al Composite

by L.M. Liu, J.T. Niu, Z.H. Lai, Y.L. Guo, and J.P. Zhai

In this paper, diffusion welding was used to weld SiCw/6061Al composites. Effects of processing paramters, such as surface condition of welding specimen, pressure, and welding temperature on joint strength and microstructure in the weld were studied, and appropriate welding methodology was identified. The paper was intended to provide the experimental data and theoretical basis for the practical application of this kind of composites.

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Age Strenghtening of Diffusion Welded Join of Al_2O_{3p}/6061Al Composite

by J.T. Niu, Y.H. Tian, B.Y. Li, J.J. Xu, and L.M. Liu

Tensile strength of diffusion welded joint of aluminum matrix composite is very low due to its poor weldability. In this paper, solution and age treatments were conducted on the welded joint of Al_2O_{3p}/6061Al composite subjected to diffusion welding using Gleeble 1500 machine, and tensile strength and microstructure of welded joint aged at 175°C were measured and analyzed respectively. Results showed that aging precipitation of welded joint is promoted effectively because of redistribution of reinforcement and a few number of dislocations in the matrix of weld zone resulting from welding pressure, and hence tensile strength of welded joint is increased significantly after aging treatment.

We want your (Gleeble) papers!

If you're doing research with a Gleeble physical simulation system and have published or presented papers on your work, we want to hear from you. We would like a copy of your paper so that an abstract can be published in the "Recent Gleeble Papers" section of the Gleeble Newsletter.

Over the years, well over 400 papers have been featured in the Gleeble Newsletter. To make sure your paper is included, mail it to Dynamic Systems Inc., P.O. Box 1234, Route 355, Poestenkill, NY 12140 USA; Fax it to 518 283-3160 or email it to info@gleeble.com.

The Gleeble Newsletter Moving to "All Electronic"

With the Winter 2007 edition, the printed version of the Gleeble Newsletter will no longer be published. It will be replaced with an electronic version of the Gleeble Newsletter that will be delivered via email as a PDF file.

Other than the form in which the newsletter is delivered, nothing else will change.

As with the previously printed version of the newsletter, the electronic Gleeble Newsletter is free. It will contain the same type of editorial content that you have come to expect from the Gleeble Newsletter. But because it will be delivered via the Internet, depending on your location, you will receive the electronic version up to two weeks sooner than the paper version delivered through postal mail.

To make sure you don't miss a single issue of the Gleeble Newsletter, sign up for the electronic edition now. Signing up is easy. Just email info@gleeble.com and tell us you want to receive the electronic version of the Gleeble Newsletter, or sign up on our website, www.gleeble.com.

Hot Zone L-Strain Fixture Measures Plastic Deformation

The 39060 Hot Zone L-Strain Fixture, equipped with alumina rods to contact the specimen, is an LVDT transducer designed for lengthwise measurement of the strain—plastic deformation—in the hot zone. The transducer, which has a total available travel of 25 mm, is equipped with two preset initial gage lengths (10 mm or 25 mm) that can be set by the user and comes complete with a calibrated signal conditioner. (For measuring elastic deformation in materials or 0.2% offset yield, see transducer models 39070, 39071, or 39072.)

For additional information, write Dynamic Systems Inc., P.O. Box 1234, Route 355, Poestenkill, NY 12140 USA; phone 518 283-5350; fax 518 283-3160 or email info@gleeble.com.

Transducer Specifications

Gage length	25 mm (1.0 inch) or 10 mm (0.39 inch)
Linearity	± 0.25% of full scale
Full scale travel	25 mm (1.0 inch)
Resolution	± 2.0 μm (0.00008 inch). This resolution is based on the electronic signal conditioning used.
Transducer type	LVDT
Maximum rate	maximum usable stroke rate is 10 mm/sec
Operating temperature	Quartz contact tips rated for continuous operation from 0°C to 1200°C (0°F to 2192°F) and limited time operation up to 1300°C (2372°F). Heat shields are required at all times. Measuring unit of transducer is rated for operation from 0°C to 100°C (32°F to 212°F). Heat shields are provided for protection of the measuring unit section of the transducer. Unit can be water cooled.

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Advances in Materials and Processing Technologies (AMPT), July 30–August 3, Las Vegas

AMPT will be held July 30 to August 3, 2006, at the Flamingo Hotel in Las Vegas, Nevada. The conference provides a forum both for senior as well as young scientists and academics around the world who are actively involved with research in the fields of Materials Science and Materials Processing to come together and share their experience of any advances they have made in those areas.

The conference scope includes:

- Materials
- Sheet forming
- Hydrostatic and hot gas forming
- Bulk forming
- Powder forming
- Forming in the melt or near-melt condition
- Material-removal processes
- Non-traditional processes
- Surface engineering
- Nano technology
- Computer applications
- Environmental issues

For more information about the conference, visit http://www.ohiou.edu/ampt/index.html

Conference Organizers invite papers from researchers and practitioners from academia as well as industry within the scope of the conference subjects. Sessions will be developed according to the level of interest for each Conference Topic.

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The Gleeble at Utah State University in Logan, Utah

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Li says. "That would be difficult to simulate on any other piece of equipment."

The Gleeble at Utah State University is a DSI factory remanufactured unit. DSI offers factory remanufactured Gleeble systems on an "as available" basis and will also remanufacture a customer's existing Gleeble system for them.

During the process, the Gleeble system is returned to the DSI factory and completely disassembled. DSI technicians then replace all worn parts with new, refinish all other components to original specifications, install all new electronics and controls, assemble the machine to original specifications, and test and recalibrate all systems on the machine. The Gleeble 1500D is then delivered and installed at the customer site. After installation, the remanufactured unit carries the same one-year warranty as all new equipment sold by DSI.

The team at Utah State is also pioneering some new uses for the Gleeble 1500D. They currently have a grant from the National Science Foundation for the study of hydrogen storage materials that could be used in hydrogen-powered vehicles. Hydrogen powered vehicles offer the promise of being extremely environmentally friendly, but there is a huge problem: a vehicle with hydrogen stored in gaseous or liquid form could literally turn into a bomb if the storage tank were ruptured.

To solve the problem, designers of hydrogen-powered vehicles would like to store the hydrogen fuel in a solid-state form so that there would be no possibility of a blast if the vehicle were involved in a collision. The key to making solid-state hydrogen storage work; however, is the speed at which the hydrogen can be moved in and out of solid-state storage.

Dr. Li and his colleagues are using the Gleeble to perform severe deformation on powdered lithium amide to fabricate nano-scale hydrogen storage materials. The idea is that as the size of the particles in the material decreases, the speed of hydrogen absorption increases because of more surface area.

To tackle the problem, the Utah State team designed a special die set for the Gleeble to accomplish the complicated deformation procedure that produces nano materials.

"So far the results are pretty promising," Dr. Li says. "Under an optical microscope, we can see that the materials are much, much finer. Now we need to verify that we have achieved nano scale with an electron microscope."

He adds, "If we have the size of particles that we want, the next step is to test whether the adsorption really speeds up at that scale."

When asked why he uses the Gleeble for this work, Dr. Li says, "On the Gleeble we can not only control all the mechanical properties, but we're in command of the thermal properties and the atmosphere. With the Gleeble, we can do complicated applications, watch what is happening, see the effect of temperature, and know how much energy is going in. It would take a lot more time and money to do it with equipment other than the Gleeble."

If the project to achieve practical solid state storage of hydrogen succeeds, hydrogen-powered vehicles of the future will not only produce far less pollution, but they will be considerably safer than today's gasoline-driven cars and trucks.

Dr. Li did his first work on a Gleeble when he studied at Rensselaer Polytechnic Institute in Troy, NY. He says, "The Gleeble 1500D is ten times better than the one I used at RPI because of the digital control. This is my dream machine. It helps my proposal writing and increases my chances to get funding."

European Gleeble Users Group Now Forming

Researchers at TU Bergakademie Frieberg are interested in starting an informal Gleeble users group for people in Europe.

If you own a Gleeble, are located in Europe, and are interested in participating in the European Gleeble Users Group, please contact:

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