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The Gleeble® NEWSLETTER

Spring 2008

DSI Launches Gleeble 3180 Physical Simulation System

Dynamic Systems Inc. has announced the latest addition to its line of Gleeble physical simulation systems, the Gleeble 3180.

The Gleeble 3180 is designed to meet the need for an affordable system that is suitable for physical simulation applications such as:

- weld HAZ,
- hot ductility,
- dilatometry,
- melting and controlled solidification, and
- hot deformation.

The Gleeble 3180 is capable of heating and cooling specimens in excess of 8,000ºC/sec, exerting 8 tons maximum force, and working specimens at 1,000 mm/sec. maximum crosshead speed. It includes a number of technical innovations, including a new grip and jaw system, a quieter hydraulic pump that sits behind the machine, and configuration changes that make the 3180 easy to install.

Windows-based computer software, combined with an array of powerful processors, allows the Gleeble 3180 operator to easily program and execute complex testing routines under precise computer control and readily capture the data that is generated.

Because the Gleeble 3180 is designed to be affordable, it is well suited for colleges, universities, and other organizations where capital budgets may be limited.

For more information about the Gleeble 3180, contact us here at DSI.

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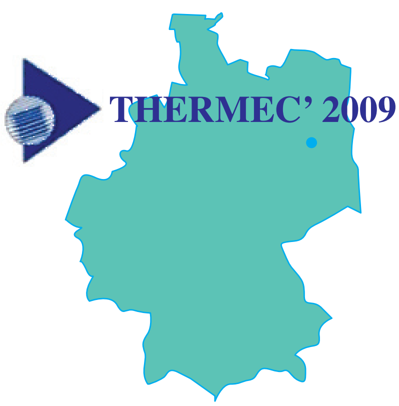
See Us at the Shows

THERMEC' 2009, August 25–29, 2009, Berlin, Germany

THERMEC' 2009, Sixth International Conference on Processing and Manufacturing of Advanced Materials will be held August 25–29, 2009, in Berlin, Germany. 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.



The last THERMEC was held in Vancouver, Canada, in 2006 and attracted over 1,250 delegates who presented over 700 papers from 35 countries.

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

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Recent Gleeble Papers

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Microfissure Susceptibility Study of a Multipass Weldment Using SICO Testing

by W.C. Chen, S.T. Mandzies, and A.W. Marshall

Gleeble® physical simulation experiments on specimens cut from a multipass weld coupon were conducted to examine microfissures in the weld. The results confirmed previous observation showing a significant difference in critical strain to fracture at each temperature from 900 to 1200°C between specimens cut from top and bottom layers of a weld, indicating higher potential for microfissure formation in the top layers. Four alloys were examined in this study using the SICO™ (Stain Induced Crack Opening) procedure. The testing procedure complies with the proposed micromechanism of the microfissure formation and is considered to be suitable for microfissure susceptibility studies in multipass welds for high alloy stainless steels and Ni-base alloys.

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Grain Refinement by Dynamic Recrystallization During Warm Deformation in ($\gamma + \alpha$) Region of Low Carbon Microalloyed Steels

by H. Hou, H. Gao, Q. Liu, H. Dong, and Y. Weng

Warm rolling (especially ferrite rolling) of ultra low carbon steels is a new rolling schedule to produce thin hot-strip steels. In the direct application of warm rolling, a major metallurgical process influencing on the mechanical properties is recrystallization. But it is generally accepted that the hot deformation of ferrite is controlled by dynamic recovery process alone. The reports of dynamic recrystallization in the ferrite range have been restricted to its occurrence in high purity materials such as zone-refined or vacuum-melted iron. Dynamic recrystallization of ferrite in IF steels containing Nb, Ti microalloying elements could occur during multi-passes deformation especially when strain rates are less than $0.1s^{-1}$. The purity of steels has significant effects on the dynamic recrystallization of ferrite. IF steels have very high purity and the interstitial atom concentrations in the steels such as C, N reach sufficient low levels, these atoms are easy to react with Nb, Ti so as to form Nb(C,N), Ti(C,N), etc. The relative absence of interstitial atoms permits the dynamic recrystallization of ferrite to occur. It is of interest that ultra-fine grain ferrite is produced by the dynamic transformation of austenite to ferrite as well as the dynamic recrystallization of ferrite when plain C-Mn steels are warm deformed in the intercritical region (i.e., in the austenite-plus-ferrite, two-phase region) by Yada *et al*. In the present study, the microstructural changes taking place during simulated warm deformation both on a Gleeble machine and a laboratory rolling mill were studied on two low carbon microalloyed steels. The grain refinement features of the dynamic recrystallization of ferrite were also studied, and mechanical properties of ultra-fine grain specimens were measured.

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Precipitation and Reheat Cracking Susceptibility of A514-Type Steels Containing Sulfur and Boron

by C. Huang, J.S. Keske, and D.K. Matlock

Reheat cracking susceptibility was evaluated in A514-type steels with different levels of sulfur and boron. Coarse-grained heat-affected zones were simulated in specimens that were later subjected to a constant load hot ductility test on a thermomechanical simulator. The removal of boron in these steels resulted in a significant reduction in susceptibility to reheat cracking. SEM observation on fracture surfaces and STEM examination on carbon replicas extracted from fracture and sectioned surfaces reveals that large particles contain Ce, S, Fe, etc., and most medium particles are of M3C type. That BN was not detected in these steels suggests that the negative effect of boron on reheat cracking may result from either grain boundary segregation of boron or increasing stability of M3C by boron partition to cementite.

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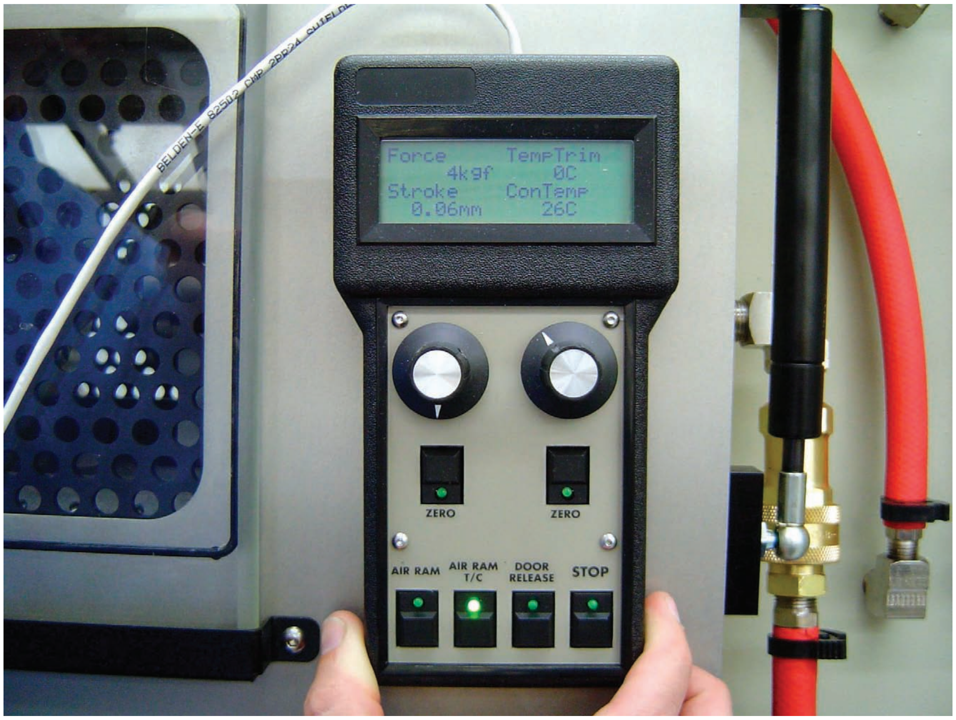
Strengthening Mechanism in Dual-Phase Acicular Ferrite + M/A Microstructures

by I.A. Yakubtsov, J.D. Boyd, W.J. Liu, and E. Essadiqi

Low carbon microalloyed plate steels for Grade 550 ($\sigma\gamma$ = 550 MPa) linepipe have a wide range of microstructures from a mixture of ferrite + bainite to completely bainite. The latter can be conventional bainite CB (nucleated at previous austenite boundaries) or acicular ferrite AF (intragranular nucleated bainitic ferrite). The best combination of strength, toughness and weldability for linepipe steels is achieved with a microstructure comprising dual phase AF+M/A (martensite/austenite constituent). The effects of thermomechanical processing (TMP) and on-line accelerated cooling (OLAC) parameters on the final microstructures have been studied extensively for these types of steels. It has been shown that to develop Grade 690 ($\sigma\gamma$ = 690 MPa) properties requires the formation of a mixture of fine AF laths and small islands of M/A constituent. It has been shown experimentally that varying TMP and OLAC parameters (austenite deformation below the non-recrystallization temperature (TNR), accelerated cooling rate ($\dot{T}$) and interrupt temperature (TI)) changes the final microstructure from a mixture of CB+M/A, through CB+AF+M/A, to a completely dual phase AF+M/A. These steels contain various microstructural features which contribute to the overall strength: i.e., boundaries of CB and/or AF laths, dislocations, solid solution alloying, microalloy precipitates and fine islands of M/A constituent. Each microstructural feature produces obstacles which have different scales, densities and magnitudes of strengthening. In this paper a quantitative description of each of these microstructural features in a dual phase AF+M/A is presented, the contribution of each to the yield strength is estimated and the appropriate approach for assessment of overall yield strength is discussed.



The Gleeble Pendant is extremely useful whenever you need to operate away from the Gleeble console.

The Gleeble Pendant—An Essential Accessory

The Gleeble Pendant is a handheld remote control that plugs into the Gleeble load unit. The system operator can use it to view and control system variables while closely observing the specimen under test. The pendant is extremely useful in any situation in which the ability to operate away from the fixed location of the Gleeble console is an advantage: for example, when performing calibrations at the back of the console, loading specimens, or observing and fine tuning processes such as melting or solidification.

The pendant measures 7.5” × 4.25” × 1.375” (19 cm × 10.8 cm × 3.5 cm). At the top of its face is a liquid crystal display (LCD) panel that can show four different system variables. Below that are two dials that can be used to increase or decrease two different system variables. The dials can be programmed to control almost any variable the operator desires. The default setting for the dials is that one controls the stroke of the mechanical unit, and the other controls the temperature trim. When either of the dials is rotated, the amount of change to the variable it controls is displayed in the LCD, so the operator knows exactly the amount of change that has been made.

Below the dials are four buttons that may be programmed to control whatever variables the operator desires. The default settings for these four buttons are: door release, air ram state, air ram condition, and stop.

DSI Applications Metallurgist Jeremy Vosburgh says, “The benefit of having a remote control is that you can have the dial and display right in front of you while you are looking inside the vacuum chamber. That allows you to closely monitor and control a test process with maximum convenience.”

For information on ordering the Gleeble Pendant, write Dynamic Systems Inc., P.O. Box 1234, Route 355, Poestenkill, NY 12140 USA; telephone 518 283-5350; fax 518 283-3160 or email info@gleeble.com.

ICPNS’ 2007 Attracts Hundreds from Around the World

The 5th International Conference on Physical and Numerical Simulation of Materials Processing, held October 23–27, 2007, in Zhengzhou, China, was attended by some 550 delegates from across the globe.

Supported by the National Natural Science Foundation of China (NSFC) and co-sponsored by 17 international societies and universities. ICPNS’ 2007 followed in the tradition of its four predecessors in Harbin (1990), Hainan (1997), Beijing (1999) and Shanghai (2004). It provided a forum for researchers around the world to present papers on recent advances in the overall field of physical and numerical methods and their applications in thermo-mechanical processing of advanced materials.

Topics included:

- Physical simulation and numerical modeling of materials and thermo-mechanical processing;
- The materials of subject including HSLA steels, TMCP steels, stainless steels, aluminum alloys, titanium alloys, magnesium alloys, composites, intermetallics, ceramics, polymer, shape memory alloy, opto-electronic materials, gradient materials, semiconductor materials and other advanced materials, such as ultra-fine grain materials and nanometer materials, etc.;
- The industrial processes of welding, bonding, heat treatment, stamping, rolling, casting/continuous-casting, forging, extrusion, superplasticity, spraying, deposition, surface engineering, self-propagating, high grade energy beam processing and other advanced technologies;
- Primary theories of physical simulation and numerical modeling;
- Development and applications of numerical simulation software;

(Continued on Page 4)

ICPNS' 2007

(Continued from Page 3)

- Computation materials science and molecular dynamics simulation;
- Prospects of physical simulation and numerical modeling on materials and thermo-mechanical processing in the 21st century.

David Ferguson, president of DSI, presented a keynote speech titled "A Look at Physical Simulation of Metallurgical Processes, Past, Present and Future." On Wednesday evening DSI hosted a party for all participants as part of the celebration of DSI's 50th anniversary.

Proceedings of ICPNS' 2007 are available. Contact Jitai NIU by emailing jtn@hit.edu.cn or jitai.niu@gmail.com.

The Gleeble Newsletter Would Like to Feature Your Work!

If you would like to see your work with the Gleeble highlighted in an article in the Gleeble Newsletter, please contact Jock Elliott, editor of the newsletter, by emailing jock.elliott@gmail.com. Mr. Elliott will contact you to arrange an interview by phone or by email.

Among the questions he would like to ask are:

- What does your organization do? If it makes products, what are they, and what industries do you supply?
- What tests are you performing with the Gleeble and on what materials?
- How does your Gleeble testing program support the overall goals of your organization?

After the interview is completed, Mr. Elliott will write an article about your work with the Gleeble and then submit it for your review. After you have reviewed and approved the article, it will be published it in a future edition of the Gleeble newsletter.

European Users Workshop—A Hands-On Experience

The European Users Workshop, held September 10–11 at Delft University of Technology, the Netherlands, proved to be a great success. Some 30 researchers from throughout Europe and as far away as Australia attended and had the opportunity to discuss their work.

A significant part of the discussion focused on how workshop participants are using Gleeble systems together with special techniques or apparatus to meet research challenges. For example, Bob De Jong talked special apparatus that had been developed for work at the University of Wollongong, Australia. Dr. Andre Moreau gave a keynote lecture on "In-situ monitoring of microstructure kinetics using laser-ultrasonics."

In all, a dozen technical papers, ranging from "Stress Relaxation Method Applied to Steels on the Gleeble" to "Melting and Solidification Experiments on Gleeble Systems" were presented.

A highlight of the workshop was the hands-on sessions that were held each day after the presentation. People could see, and participate in, the running of a variety of tests and other activities related to maintenance, melting and solidification, hot deformation using the Hydrawedge, and stress relaxation.

In the words of David Ferguson, "Everyone went away with a really positive experience and the unanimous agreement that we should hold another workshop in the future."

We Want Your 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 500 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 very first Gleeble 3180 and the team that made it happen.