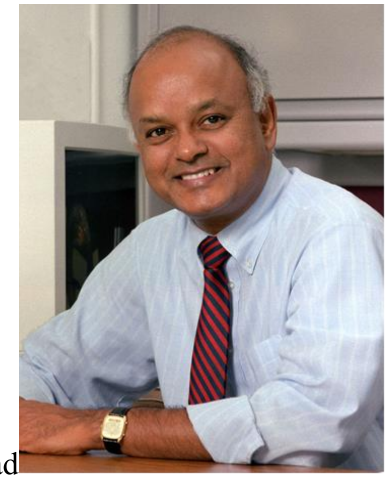
Curriculum Vitae

Stan A. David

Oak Ridge National Laboratory



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Research Interests

- Materials Engineering
- Welding Metallurgy
- Welding Processes including Friction Stir Welding and Processing
- Joining of Ceramics-to-Metals
- Solidification Processing, Composites, Alloy Design
- Metallography

Education

- 1972 Ph.D. University of Pittsburgh
- 1967 M.S. Indian Institute of Science
- 1965 B.S. Indian Institute of Science
- 1963 B.SC St. Joseph College

Employment

- 2008 – Present-Corporate Fellow Emeritus, Consultant
- 1992 – 2008- Corporate Fellow, and Group Leader, Materials Joining Group, Oak Ridge National Laboratory (ORNL)
- 1983 – 1992- Group Leader, Materials Joining and Nondestructive Group, ORNL
- 1977 – 1983- Research Staff Member, ORNL
- 1973-1977- Research Associate Professor, University of Pittsburgh

Professional Activities

- 2018- Fellow IIW (International Institute Of Welding)
- 2001- Fellow, TMS (Minerals, Metals and Materials Society)
- 1994- Fellow, American Welding Society
- 1993- Fellow, American Association for the Advancement of Science
- 1984- Fellow, ASM International
- 2018- Fellow, IIW. International Institute of Welding
- 1993- Present - Member- Panel, Naval Studies Board, National Research Council (NRC)
- American Institute for Mining, Metallurgy & Petroleum Engineers
- Internal Institute of Welding (IIW) U.S. Delegate
- Officer/Committee
- American Institute for Mining, Metallurgy & Petroleum Engineers
- ASM International, American Welding Society

SUMMARY

STAN A. DAVID

Specific Outstanding Technical and Professional Engineering Accomplishments

Dr. Stan David is recognized nationally and internationally for his extensive contributions to welding science and solidification through innovative experimental techniques and associated theories. After receiving his Ph.D. in metallurgical engineering from the University of Pittsburgh in 1972, Stan remained at the university as a research professor until 1977. At that time, he joined the Materials Joining Group in the Metals and Ceramics Division, Oak Ridge National Laboratory (ORNL) and became group leader in 1983. In 1992 he was selected as a Corporate Fellow of Martin Marietta Energy Systems, an honor conferred on only a very few elite scientists and engineers. He was the task leader of DOE Basic Energy Sciences Welding Science Program for 25 years providing leadership for advancing welding science and technology . Some of his accomplishments in welding research are described below. Dr. David has been appointed as Adjunct Professor at the University of Pittsburgh and Colorado School of Mines, and Visiting Professor at Coventry University, Coventry, U.K.

Neutron Scattering Studies to Measure Residual Stresses in Weldments

Dr. David was one of the three man team (Steve Spooner and Cam Hubbard) to measure for the first time in the United States, residual stresses in weldments using neutron scattering.. This was responsible for establishing a user center for measuring residual stresses in structures using neutrons at ORNL.

Dr. David, jointly with colleagues at ORNL, is pursuing recently initiated research activities related to neutron scattering to measure residual stresses in weldments. This activity is both nationally and internationally significant. A major concern in welded structures for nuclear and non-nuclear applications is residual stresses and distortion. Residual stresses can lead to crack formation and ultimate failure of the structural member. Using the ORNL Laboratory Director's

Research and Development Fund, the group has been able to establish a proven capability at ORNL to measure residual stresses in structural members using neutron scattering experiments. For the first time in the US, they were able to map 3-D residual stresses in a multiphase weldment. Because of the industrial significance and expressed interest from various industries in this field, the ORNL scientists are in the process of establishing an industrial consortium to carry out further research and development activities related to residual stresses. These initiatives have resulted in establishing a neutron scattering residual stress measurement User's Center at ORNL. In addition, a fundamental study to investigate the effects of compositional variations on the accuracy of stress measurements is underway. Taking advantage of the deep penetration capability of neutrons, Dr. David and his colleagues have measured in-situ for the first time the transient thermal stress, temperature and dynamic recrystallization during friction stir welding a solid state joining and material processing technology based on very high strain rate and extreme material flow/deformation.

Fundamental Studies of Austenitic Stainless Steel Welds

Also early in his career at ORNL, Dr. David initiated a highly regarded Basic Energy Sciences-funded Welding Science Program focused on the weld pool solidification behavior of austenitic stainless steels. This class of material was selected for initial investigations because of its universally recognized weld-cracking problems and the major importance that it plays in all types of energy systems (including, of course, nuclear) as well as many other industrial applications such as petrochemical and aerospace. Some of his contributions and recognitions in the fundamental program on stainless steels include:

- Identified the solidification sequences and developed a model to explain the origin of duplex and fully austenitic structures in welds. Received American Welding Society McKay-Helm Award in 1979 and the James F. Lincoln Gold Medal in 1981 for this and related research.

- Appointed by the U. S. Department of Energy in 1988 to coordinate the national Basic Energy Sciences Welding Science programs. These programs involved research at five laboratories throughout the country and are considered to be the premier government-funded welding research efforts in the nation.

- Identified (for the first time) changes in the mode of freezing of austenitic stainless steel welds depending upon cooling rate conditions. Produced the first major modifications to the internationally used Schaeffler constitution diagram for stainless steel weld metal since it was developed in the mid-1940's; this modification consisted of a three-dimensional model which successfully predicts microstructures over a wide range of cooling rates and compositions.

- Determined the sequences of phase and compositional changes that occur in austenitic stainless steel weldments when used in service, including nuclear power plants, at elevated temperatures in the 475-850° range. Defined the role of such controlled residual elements (CRE) as titanium and boron, which can be added to stainless steel welds to enhance the creep-rupture properties. Received prestigious 1990 Jacquet-Lucas Gold Medal awarded jointly by the International Metallographic Society (IMS) and ASM International. (Incidentally, this was the third time that Dr. David won this award, a feat never accomplished by anyone in the history of these societies.)

- Initiated and serves as a principal investigator on an international program to study the microstructural development in stainless steel single crystal welds. Established new analytical methods that successfully explain and predict dendritic selection and growth patterns in the solidified weld metal. Contribution was recognized by the 1988 Jacquet-Lucas Gold Metal award (one of three noted previously); additionally Pratt and Whitney Aircraft Corporation provided single crystal turbine blade alloys for a preliminary investigation into repair welding of aircraft turbine blades. Recently, Stan's work on single crystal welds has resulted in the successful development of a Cooperative Research and Development Agreement (CRADA) with Westinghouse Electric Corporation to investigate the welding of high-nickel superalloy single crystals for land-based turbine applications.

Welding and Weld Repair of Nickel Base Superalloy Single Crystal Turbine Blades

Dr. David's pioneering fundamental work on welding of stainless steel single crystals is being extended to weld and repairing commercial nickel base superalloy single crystal turbine blades. Welding of commercial nickel base superalloy single crystals poses challenges of avoiding hot-cracks and the formation of stray grains in the weld. He and his colleagues are working on a major DOE Program with Industrial Partners to address these challenging issues. Further Dr. David is also leading an International Proliferation Prevention Program on weld repair of gas turbine alloys jointly with Paton Welding Institute and Pratt & Whitney.

In-Situ Characterization of Weld Microstructure Development

Dr. David and his colleagues have also performed novel in-situ experiments using Transparent Organic Metal Analog Systems and Time Resolved X-ray Diffraction (TRXRD) using synchrotron source to characterize weld pool microstructure development and phase selection during welding of low alloy steels, respectively. The welding studies of Transparent Metal Analog System have shown the dynamics of microstructure evolution and defect formation during welding. In-situ TRXRD experiments have revealed equilibrium and non-equilibrium phase selection processes in low alloy steel welds during slow cooling and rapid cooling of the weld metal, respectively. These studies are critical to the design of welding consumables.

Friction Stir Welding

Dr. David is actively involved in leading a team of researchers on friction stir welding (FSW) process. Activities in this area currently include friction stir tool alloy design for FSW steel, titanium, and other high temperature materials, process modeling and characterization of residual stresses and distortion in FSW. Dr. David and his colleagues are carrying out pioneering work to advance our understanding of the FSW processes using in-situ neutron diffraction characterization of transient thermal stress, temperature and dynamic recrystallization. In the process development arena Dr. David and his colleagues have developed a hybrid process that successfully combines laser heat source to friction stir welding system. The combination has been shown to be extremely powerful to FSW high temperature alloys such as nickel base superalloys and titanium.

Macro- and Microstructure Development in Low-Alloy Steel Welds

Dr. David, along with his colleagues, has been instrumental in developing a research project to study the development of macro- and microstructures in low alloy steel weld metal. The research pertains to the nonmetallic oxide inclusion formation and effect of these inclusions on the solid state transformations in steel welds. The research has led to greater understanding of various complex deoxidization reactions that occur in the liquid steel weld metal, which, in turn, leads to the formation of oxide inclusions. A model based on ladle metallurgy and overall transformation kinetic theories have been developed to describe the inclusion formation. This model is capable of predicting the inclusion composition, number density, size and the sequence of oxide formation as a function of weld metal composition and cooling rate. The publication of this work in an international journal has received much acclaim from overseas reviewers. This research is important to the development of welding consumables to produce high quality and economical steel structures used in the energy industries and development of special steels. It is noteworthy that the research is already being applied to the development of welding consumables for a high strength steel-welding project of the U.S. Navy. Presently, the effects of inclusions on the solid state transformation characteristics and interaction of elastic stress with solid state transformations are also being pursued to develop welding consumables with desired microstructures.

Mathematical Modeling Related to Welding

Dr. David's research and that of others at ORNL under his direction, in the area of mathematical modeling, has received much national and international visibility. The research led to the development of a comprehensive modeling capability to predict weld pool shapes. A key aspect of this research has been the development of a fast transient 3-D model and experimental study to quantitatively understand the influence of heat flow and fluid flow in the transient development of the weld pool during gas tungsten-arc and laser beam welding. Large variations in the depth of melting between different heats of the same material such as austenitic stainless steel presents a major problem in making reproducible welds and has received much industrial attention over many years. The modeling study at ORNL has shown the importance of considering the effects of surface active elements, particularly on weld pool surface temperature and its influence on fluid flow and heat transfer that occur during welding. Further, the existing fast transient 3-D model has been recently modified to include other temperature dependent properties in order to simulate realistic welding situations.

Welding of Single Crystals

Through novel experiments using austenitic stainless steel and nickel base superalloy single crystals, Dr. David has carried out pioneering studies in the area of weld pool solidification. He has developed a geometrical analysis to predict the dendrite growth selection process within the weld pool and the resulting weld microstructures. Results of these studies have significantly enhanced our fundamental understanding of the weld pool solidification. Also this work is being extended to weld or repair nickel base superalloy single crystal turbine blades. A series of papers published on this subject in the Metallurgical Transactions was awarded the Champion H. Mathewson Award by the Minerals, Metals, and Materials Society (TMS). Also for this work the Institute of Materials, London, awarded him the Elegant Work Prize.

Welding of Ductile Ordered Intermetallic Alloys

In the area of joining of ductile ordered intermetallic alloys, David clearly holds the leadership in the world. His studies on the welding of Co_3V, Ni_3V, Ni_3Al, Fe_3Al, and Ti_3Al have established most of the welding metallurgy fundamentals for these new classes of advanced materials. He was able to demonstrate the criticality of composition and welding parameters on the weldability of these alloys. In particular, he led the research to establish the critical amounts of boron in Ni_3Al alloys and Fe_3Al alloys to allow successful welding without cracking. He also demonstrated the effect of weld thermal cycles on microstructure and properties of these alloys.

Weld Cracking in Radioisotopically Powered Heat Sources

One of Dr. David's early responsibilities at Oak Ridge was involved with a weld-cracking problem in the iridium alloy structural member of a radioisotopically-powered heat source. When the weld cracking threatened to cause major delays in the NASA mission for outer planetary exploration of space, he conceived and successfully carried out a research program to specify sound welding practices to eliminate the cracking. He identified the influence of thorium content and fusion zone grain size on the weldability and weld metal properties; additionally he devised an evaluation test for thin sheets of material to identify heats of iridium alloy having poor or marginal weldability. Throughout the period of this research, Stan served on the National Iridium Alloy Welding Advisory Committee and in 1989 and 1990 received Outstanding Achievement Awards from the U. S. Department of Energy.

Welding of Thick-Section Ferritic Steels Using the Electron Beam Process

Dr. David and his colleagues demonstrated the feasibility of welding thick-section ferritic steels (such as might be applied to nuclear pressure vessels) using high power electron beams. In addition to showing potential technical and economic advantages of the process, further research in this area addressed the formation of soft areas in the heat affected zones of weldments that have led to premature failure. Through extensive high-resolution electron microscopy, the study identified the gradation in microstructures that exist in the soft zones of the ferritic steel weldments.

University Interactions

Dr. David has been appointed as Adjunct Professor at the University of Pittsburgh and

Colorado School of Mines. He is also a Visiting Professor at Coventry University, Coventry, U.K. He has co-advised 2 Ph.D. students and several M.S. Students at Colorado School of Mines. He has mentored several undergraduate students from South Dakota School of Mines during summer internship programs at ORNL. He has guided the research of several post doctoral fellows and visitors from overseas at ORNL

Journal and Conferences

He is the founding editor-in-chief of the scientific journal, Science and Technology of Welding and Joining published by Taylor and Francis in London He is also the Founder and Chair and Co chair of ten Trends in Welding Research Conferences.

Awards and Honors

. **Fellow, IIW, International Institute of Welding, 2018**

- Distinguished Vising Lecturer, Shanghai, Xintao University, Shanghai, China, 2015
- GE Global Research Center Distinguished Lecture Materials Science and Engineering at RPI Troy, New York, 2004
- UT-Battelle Director's Award, 2003
- UT-Battelle Distinguished Engineer Award, 2003
- Arata Prize Winner (International Institute of Welding), 2002
- Warren F. Savage Memorial Award, 2002
- McKay-Helm Award, American Welding Society, 2002
- Fellow, TMS (Minerals, Metals and Materials Society), 2001
- Distinguished Alumnus, University of Pittsburgh, 1998
- Warren F. Savage Memorial Award, American Welding Society, 1998
- Elegant Work Prize, The Institute of Materials, London, 1997
- Editor-In-Chief, "Science And Technology Of Welding And Joining," (Journal), 1996
- William Irrgang Memorial Award, American Welding Society, 1996
- Champion H. Mathewson Award, Minerals, Metals, and Materials Society, 1994
- Fellow, American Welding Society, 1994
- Fellow, American Association for the Advancement of Science, 1993
- Comfort A. Adams Lecturer, American Welding Society Annual Meeting, Houston, Texas, 1993
- Charles H. Jennings Memorial Award, American Welding Society, 1993
- Martin Marietta Energy Systems Corporate Fellow, 1992
- Adjunct Professor, Colorado school of Mines, Golden, CO.
- Visiting Professor, Coventry University, Coventry, UK.
- Honorary Membership Award, American Welding Society, 1992
- Charles H. Jennings Memorial Award, American Welding Society, 1990
- Jacquet-Lucas Gold Metal Award, International Metallographic Society and ASM International, 1987, 1988, 1990
- Martin Marietta Energy Systems Technical Achievement Award, 1989, 1987
- Martin Marietta Energy Systems Publication Award, 1988
- Fellow of the American Society for Metals, 1984
- James F. Lincoln Gold Metal, American Welding Society, 1982
- McKay-Helm Award, American Welding Society, for the Best Contribution in the Field of Welding, 1980

Founding Member

- Journal – Founding Member, EdItor in Chief of the Journal Science and Technology of Welding and Joining, Published by Maney Publications.
- Conferences – Founding member and chairman of the International Conference, International Trends in Welding Research (1986, 1989, 1992, 1995, 1998, 2001, 2012).

Patents

1. U.S. PATENT 4,499,758, "Assembly for Testing Weldability of Sheet Metal," (with J. J. Woodhouse).

2. U.S. PATENT 4,621,761, "A Process for Forming Unusually Strong Joints Between Metals and Ceramics by Brazing at Temperatures That Do Not Exceed 750ºC," (with J. P. Hammond and J. J. Woodhouse).

3. U.S. PATENT 5,320,802, "Corrosion Resistant Iron Aluminides Exhibiting Improved Mechanical Properties and Corrosion Resistance," (with C. T. Liu, C. G. McKamey, and P. F. Tortorelli)

4. U.S. PATENT 7,762,447 B2, "Multiple Pass and Multiple Layer Friction Stir Welding and Material Enhancement Processes" (With Zhili Feng and David Alan Frederick)

5. U.S. PATENT 8,061,579 B2, "Friction Stir Method For Forming Structures and Materials" (with Zhili Feng and David Alan Frederick)

6. U.S. PATENT 12816413 (with Zhili Feng and David Alan Frederick)

7. U.S. PATENT 14614439. "Welding Methods for Hydrogen Embrittlement Control," (with Zhili Feng, Stan A. David, Demetrios Alkiviadis Tzelepis)

8. U.S. PATENT 12816403, "Friction Stir Method for Joining Complex Shapes," (with Zhili Feng, Stan A. David, David Alan Frederick)

Books Edited

1. Trends in Welding Research, ed. by S. A. David, T. DebRoy, John Dupont and J. M. Vitek, ASM-International, Materials Park, Ohio, (2012)

2. Trends in Welding Research, ed. by S. A. David, T. DebRoy, J. C. Lippold, H. B. Smartt, and J. M. Vitek, ASM-International, Materials Park, Ohio (2006).

3. Trends in Welding Research, ed. by S. A. David, T. DebRoy, J. C. Lippold, H. B. Smartt, and J. M. Vitek, ASM-International, Materials Park, Ohio (2003).

4. Trends in Welding Research, ed. by J. M. Vitek, S. A. David, J. A. Johnson, H. B. Smartt, and T. DebRoy, ASM-International, Materials Park, Ohio (1999).

5. H. B. Smartt, J. A. Johnson, and S. A. David, eds., "International Trends in Welding Science and Technology," Conference Proceedings, ASM International, June 1995.

6. S. A. David and J. M. Vitek, eds., "International Trends in Welding Science and Technology," Conference Proceedings, ASM International, March 1993.

7. S. A. David and J. M. Vitek, eds., "Recent Trends in Welding Science and Technology," Conference Proceedings, ASM International, January 1990.

8. S. A. David, ed., "Advances in Welding Science and Technology," Conference Proceedings, American Society for Metals, March 1987.

9. S. A. David co-ed., "Grain Refinement in Castings and Welds," Conference Proceedings of the Metallurgical Society of AIME, 1983.

10. S. A. David and G. M. Slaughter, "International Conference on Welding Technology for Energy Applications," Oak Ridge National Laboratory, 1982.

11. S. A. David ed., "Trends in Welding Research in the United States," Conference Proceedings, American Society for Metals, November 1982.

Book Chapter

1. S. A. David, "Welding of Stainless Steels," Encyclopedia of *Mater. Sci. and Engr*., ed. M. B. Bever, Pergamon Press, Oxford, UK (1986).
2. S.A. David, S.S. Babu and J.M. Vitek. 2002. "Welding," *Encyclopedia of Materials: Science and Technology, ISBN: 0-08-043152-6, Pergamon,* April 17, 2003, 1-9. (BOOK)
3. S. A. David, S. S. Babu and J. M. Vitek, "Welding," Elsevier Ref book, 2016.
4. S. A. David, J. Chen, B. T. Gibson, Zhili Feng, "Intelligent Weld Manufacturing: Role of Integrated Computational Welding Engineering," *Transactions on Intelligent Welding Manufacturing,* 2018, 3-30. (BOOK)

Publications

Journals (Peer Reviewed)

1. S. A. David and H. D. Brody, "Growth of Niobium-Niobium Carbide (Nb_2C) Eutectic and Off-Eutectic Composites by Zone Melting," *Met. Trans*. **5**, 3209-2316 (1974).
2. S. A. David and H. D. Brody, "Banding in Niobium-Niobium Carbide (Nb_2C) Composite Grown by Zone Melting," *Met. Trans*. **5**, 2608-2610 (1974).
3. G. J. Scherbakov, S. A. David, and H. D. Brody, "Growth of Pb-Bi Peritectic Alloys at Moderate and High Values of G/R," *Scripta Met.* **8(11),** 1239-43 (1974).
4. S. A. David and H. D. Brody, "The Growth and Thermal Stability of Niobium-Niobium Carbide (Nb_2C) Composites from the Melt," Proceedings of the International Conference on Composite Materials, Geneva-Boston, 806-19 (1976).
5. S. A. David, A. T. Santhanam, and H. D. Brody, "Growth Crystallography and Its Influence on Lamellar to Rod Transition in Directionally Solidified Nb-Nb_2C Eutectic Composites," *Met. Trans.* **7**, 1051-55 (1976).
6. S. A. David, G. M. Goodwin, and D. N. Braski, "Solidification Behavior of Austenitic Stainless Steel Welds," *Weld. J.* **58(11)**: 330s-336s (November 1979).
7. S. A. David, "Ferrite Morphology and Variations in Ferrite Content in Austenitic Stainless Steel Welds," *Weld. J.* **60(4)**: 63s-71s (April 1981).
8. V. K. Sikka and S. A. David, "Discontinuous Creep Deformation in a Type 316 Stainless Steel Casting," *Met. Trans. A* **12A**, 88-92 (May 1981).

9. S. A. David and C. T. Liu, "High- Power Laser and Arc Welding of Thorium-Doped Iridium Alloys," *Weld. J.* **61(5)**, 157s-163s (May 1982).

10. C. T. Liu and S. A. David, "Weld Metal Grain Structure and Mechanical Properties of Th-Doped Ir-0.3 Pct W Alloy (Dop-26)," *Metall. Trans. A* **13A**, 1043-53 (June 1982).

11. D. N. Braski and S. A. David, "Weld Microstructure of $(Ni,Fe)_3(V,Ti)$ Long-Range-Ordered Alloy," *Metall. Trans. A* **14A**, 1785-91 (September 1983).

12. J. M. Vitek, S. A. David, and A. DasGupta, "Microstructural Modification of Austenitic Stainless Steels by Rapid Solidification," *Met. Trans.* **14A**, p. 1833 (1983).

13. H. Inouye and S. A. David, "Segregation and Influence of Boron on the Impact Toughness of Ti-6 Pct A1-2 Pct Nb-l Pct Ta-0.8 Pct Mo Welds and Castings," *Met. Trans. A* **15A**, 1505-08 (July 1984).

14. J. M. Vitek and S. A. David, "The Solidification and Aging Behavior of Types 308 and 308CRE Stainless Steel Welds," *Weld. J.* **63(8)** 246s-253s (August 1984).

15. J. C. Griess, S. A. David, and R. J. Gray, "Electrochemical Etching of Titanium Alloy Castings," *J. of Applied Electrochemistry* **14,** 573 (1984).

16. S. A. David, W. A. Jemian, C. T. Liu, and J. A. Horton, "Welding and Weldability of Nickel Aluminides," *Weld. J.* **(64)1**: 22s-28s (Jan. 1985).

17. J. M. Vitek and S. A. David, "Metastable Equilibrium of Ferrite in Type 308 Stainless Steels," *Scripta Met.*, **19** (1985).

18. J. M. Vitek and S. A. David, "The Concept of an Effective Quench Temperature and Its Use in Studying the Elevated Temperature Microstructures," *Met. Trans*. (August 1985).

19. J. M. Vitek and S. A. David, "The Sigma Phase Transformation in Austenitic Stainless Steels," *Weld. J.* **65(4)**: 106s-llls (April 1986).

20. S. A. David, D. N. Braski, and C. T. Liu, "Structure and Properties of Welded Long-Range-Ordered Alloys," *Weld. J.* **65(4)**: 93s-98s (April 1986).

21. M. L. Santella and S. A. David, "A Study of Heat-Affected Zone Cracking in Fe-Containing Ni_3Al Alloys," *Weld. J.* **65(5):** 129s-137s (May 1986).

22. S. A. David, "Trends in Welding Research," *J. of Metals*, **38(5)** 37-38 (May 1986).

23. J. F. King, S. A. David, J. E. Sims, and A. M. Nasreldin, "Electron Beam Welding of Heavy-Section 3Cr-1.5Mo Alloy," *Weld. J.* **65(7)** 39-47 (July 1986).

24. V. P. Kujanpää, S. A. David, and C. L. White, “Formation of Hot Cracks in Austenitic Stainless Steel Welds-Solidification Cracking," *Weld. J.* **65(8):** 203s-212s (August 1986).

25. S. A. David and J. J. Woodhouse, "Weldability Test for Thin Sheet Materials and Its Application," *Weld. J.*, **66(5):** 129s-134s, (May 1987).

26. J. M. Vitek and S. A. David, "The Aging Behavior of Homogenized Type 308 and 308 CRE Stainless Steel," *Met. Trans. A*, **18A:** 1195-1201 (July 1987).

24. V. P. Kujanpää, S. A. David, and C. L. White "Characterization of Heat-Affected Zone Cracking in Austenitic Stainless Steel Welds," *Weld. J.* **66(8):** 221-228 (Aug. 1987).

27. S. A. David, J. M. Vitek, J. R. Keiser, and W. C. Oliver, "Nanoindentation Microhardness Study of Low-Temperature Ferrite Decomposition in Austenitic Stainless Steel Welds," *Weld. J.* **66(8):** 235s-240s (Aug. 1987).

28. S. A. David, J. M. Vitek, J. R. Keiser, and W. C. Oliver, "Use of a Mechanical Properties Microprobe in the Study of Weld Metal Transformations," *Met. Trans. A* **18A**, 1996-1999 (Nov. 1987).

29. S. A. David, J. M. Vitek, and T. L. Hebble, "Effect of Rapid Solidification on Stainless Steel Weld Metal Microstructures and Its Implications on the Schaeffler Diagram," *Weld. J.* **66(10)**: 289s-300s (October 1987).

30. P.A.A. Khan, T. DebRoy, and S. A. David, "Laser Beam Welding of High-Manganese Stainless Steels - Examination of Alloying Element Loss and Microstructural Changes," *Weld. J.* **67(1):** 1s-7s (January 1988).

31. M. L. Santella, J. A. Horton, and S. A. David, "Welding Behavior and Microstructure of a Ni_3Al Alloy," *Weld. J.* **67(3):** 63s-69s (March 1988).

32. J. M. Vitek and S. A. David, "The Effect of Cooling Rate on Ferrite in Type 308 Stainless Steel Weld Metal," *Weld. J.* **67(5):** 95s-102s (May 1988).
33. M. C. Maguire, G. R. Edwards, and S. A. David, "The Effect of Domain Structure on the Hot Ductility of Ni-Cr Aluminides," *Scr. Metall*. **22**, 1213-7 (1988).
34. J. P. Hammond, S. A. David, and M. L. Santella, "Brazing Ceramic Oxides to Metals at Low Temperatures," *Weld. J.* **67(10):** 227s-232s (Oct. 1988).
35. M. L. Santella, M. C. Maguire, and S. A. David, "Analysis of Heat-Affected Zone Cracking in Ni_3Al Alloy Welds by Computer Modeling of Thermal Stresses," *Weld. J.* **68(1):** 19s-27s (January 1989).
36. T. Zacharia, S. A. David, J. M. Vitek, and T. DebRoy, "Heat Transfer During Nd:YAG Pulsed Laser Welding and Its Effect on Solidification Structure of Austenitic Stainless Steels," *Met. Trans. A* **20A**, 957-967 (May 1989).
37. M. Rappaz, S. A. David, J. M. Vitek, and L. A. Boatner, "Development of Microstructures in Fe-15Ni-15Cr Single Crystal Electron Beam Welds," *Met. Trans. A* **20A**, 1125-38 (June 1989).
38. S. A. David, J. A. Horton, C. G. McKamey, T. Zacharia, and R. W. Reed, "Welding of Iron Aluminides," *Weld. J.* **68(9):** 371s-381s (September 1989).
39. T. Zacharia, A. H. Eraslan, D. K. Aidun, and S. A. David, "Three-Dimensional Transient Model for Arc Welding Process," *Met. Trans. B* **20B (5),** 645-659 (October 1989).
40. S. A. David and J. M. Vitek, "Correlation Between Solidification Parameters and Weld Microstructures," *Int. Mater. Rev.* **34(5),** 213-45 (1989).
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