Simulation of welding

Chuan-Song WU¹, Michael RETHMEIER², and Christopher SCHWENK²

¹ Institute of Materials Joining, Shandong University, Jinan, China

² Federal Institute for Materials Research and Testing (BAM), Berlin, Germany

© Higher Education Press and Springer-Verlag Berlin Heidelberg 2011

Welding has become the most important materials processing technology in manufacturing, and has critical effects on the quality, reliability and life of products as well as production cost, efficiency and response speed to market. As various kinds of high performance metallic materials are widely used in engineering, there are more demands in manufacturing industry for advanced welding technology. In order to research and develop new welding processes with high quality, high efficiency, low cost and environment-friendly features and to ensure the safety and reliability of weld structures, it is essential to conduct modeling and simulation of welding physical phenomena and process mechanisms. In this century of information technology, modeling and simulation have become powerful tools for welding research and development. Through combining the scientific simulation approaches with less experimental calibrations, welding technology will be transformed from the previous mode “theory-experiment-production” to the new mode “theory-computer simulation-production”. Till now, lots of investigations have been done and great progress has been made in the relevant areas, and scientists from both China and Germany have made influencing achievements in modeling and simulation of welding. To provide a forum for Sino-German scientists who are engaged in research activities related to welding and joining to exchange information and discuss on the state-of-the-art in welding simulation and modeling, the *1st Sino-German Workshop on Simulation of Welding* was held in Berlin, Germany, on October 26th-29th, 2010, under the sponsorship of the Sino-German Center for Science Promotion.

This Special Issue of *Frontiers of Materials Science* draws on the contributions presented at the *1st Sino-German Workshop on Simulation of Welding*. Following an initial screening of the presented contributions by the Organizing Committee of the Workshop, the papers were peer-reviewed in the standard manner for *Frontiers of Materials Science* and revised, eventually producing the selection of 17 papers included in the present issue. The main content of the issue involves the numerical simulation and experimental measurement of the welding physics, process mechanisms, residual stress and distortion, cracking mechanism, and the development and applications of welding

engineering software packages. We expect that the publishing of the special issue can promote the deep research of welding simulation in both China and Germany.

We would like to express our gratitude to the Editors of *Frontiers of Materials Science*, and the productive editors at Higher Education Press and Springer Press, for the time and effort they have given in order to ensure the successful publication of this Special Issue.

Co-Chairmen of the Workshop:

Chuan-Song WU

Michael RETHMEIER

Secretary-General of the Workshop:

Christopher SCHWENK

Prof. Chuan-Song WU
E-mail: wucs@sdu.edu.cn

WU obtained his BS, MS and PhD degrees from Harbin Institute of Technology in 1982, 1984 and 1988, respectively. Then he worked at Harbin Institute of Technology and became a full professor there in 1991. Since 1996 he has been a professor of materials welding & joining at Shandong University, China. As Humboldt Scholar and/or Guest Professor, WU has been invited to have quite a few of research stays at famous universities and institutes in USA, Germany and Japan. His research interests include numerical simulation, process monitoring and control of welding processes. He has authored/coauthored over 176 papers published on peer-reviewed journals, and also authored three books and two book chapters.

Prof. Michael RETHMEIER
E-mail: Michael.Rethmeier@bam.de

RETHMEIER studied mechanical engineering at the Technical University in Braunschweig, Germany. Afterwards he worked at the Institute for Welding Technology at the same university where he received his PhD degree. In 2003, he became corporate research project manager at the Volkswagen AG group research, Wolfsburg where he was responsible for production engineering and concepts. In 2007 he got his full professorship of the Technical University of Berlin in combination with being the head of the Division Safety of Joined Components at the Federal Institute for Materials Research and Testing BAM in Berlin, Germany. Additionally, he is the Division director of Joining and Coating Technology of the Fraunhofer Institute for Production Systems and Design Technology IPK in Berlin. RETHMEIER's main

research areas are welding simulation, high-power laser beam welding, arc welding, component testing, and resistance spot welding of high strength steels.

Dr. Christopher SCHWENK
E-mail: Christopher.Schwenk@bam.de

SCHWENK obtained his diploma in 2004 at the Technical University in Braunschweig, Germany. Then he went to the Volkswagen AG group research, Wolfsburg, where he received his PhD degree from the Technical University of Berlin in the field of welding simulation in 2007. In 2006 he got the IIW Kenneth Easterling Award for his work about the sensitivity analysis of welding simulation. His scientific research covers the simulation, prediction and optimization of welding induced temperature fields, distortions and stresses for all welding techniques. Since 2007, SCHWENK has been the team leader for welding simulation and arc welding in the division "Safety of Joined Components" at the Federal Institute for Materials Research and Testing BAM in Berlin, Germany.