U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Multimaterial Joining Workshop - Monday July 23, 2012

Workshop Overview

This Advanced Manufacturing Office (AMO) workshop will gather input from stakeholders in industry and academia on the current state of the art, and identify emerging applications, barriers and actions to advance multimaterial joining technologies. Specifically, AMO wants to learn more about the current state of multimaterial joining research and industry trends; identify high value opportunities and emerging applications; identify challenges and barriers to research, development and implementation of multimaterial joining technologies at commercial scale; and identify actions needed to advance the use of multimaterial joining technologies for commercial and industrial applications.

Participants will learn about AMO – our program vision, goals, and initiatives -- and be encouraged to network with other leaders in this technical field. Participants are asked to provide their individual perspective during discussions.

Workshop participants should NOT: discuss specific budget formulation activities, procurement-sensitive or proprietary activities including recent solicitations or awardees; promote specific multimaterial joining technologies or products; or identify the specific technical solutions to problems that are identified. Participants will NOT be asked to reach consensus on or prioritize any subjects under discussion.

Background

Manufacturing converts a wide range of raw materials, components, and parts into finished goods that meet market expectations. The Advanced Manufacturing Office (AMO) partners with industry, small business, universities, and other stakeholders to identify and invest in emerging technologies with the potential to create high-quality domestic manufacturing jobs and enhance the global competitiveness of the United States. More about the AMO mission and goals can be found at: http://www1.eere.energy.gov/manufacturing/about/goals.html.

AMO has a number of advanced manufacturing initiatives including the Innovative Manufacturing Initiative (IMI) and Manufacturing Demonstration Facilities (MDFs). More information about these and other initiatives can be found at: http://www1.eere.energy.gov/manufacturing/rd/index.html

Ground Rules

- No Speeches
- Listen to Each Other
- Suspend Judgment
- Challenge Ideas, not People

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Multimaterial Joining Workshop - Monday July 23, 2012

Agenda

8:00am-9:00am **Registration and Breakfast**

9:00am-9:15am **Welcome and Introductory Remarks** **Stephen Sikirica**

9:15am-10:15am **Multimaterial Joining Overview** **Expert Panel**

4 10-minute overview presentations each followed by 5 minutes of Q&A

Purpose:

- Evaluate current status of multimaterial joining technologies including adhesives, mechanical joining, friction stir solid state processes, and laser, electron beam, microwave, and other approaches
- Identify remaining challenges
- Identify high priority R&D needs

10:15am-10:20am **Facilitation Instructions** **Marci DuPraw and Lee-Ann Tracy**

10:20am-10:30am **Break**

10:30am-12:00pm **Breakout Session: Opportunities and Emerging Applications** **Two concurrent sessions**

- Review ground rules and identify a group reporter.
- What are high value opportunities and emerging applications for multimaterial joining?
  Characteristics to consider: changing the life-cycle impact (energetic or economic) of manufactured products; creating value in multiple supply chains; applying to many industrial/use domains; representing a competitive capability for the United States.
- List the opportunities.

12:00pm-1:00pm **Lunch and Networking Session**

1:00pm-2:15pm **Breakout Session: Challenges and Barriers** **Two concurrent sessions**

- For the high value opportunities identified in the first breakout session, what are the barriers, challenges, and needs to realize the application and increase adoption of multimaterial joining technologies?
  A barrier could be technical – for example, materials characteristics, simulation or process modeling, or manufacturing challenges; or non-technical -- such as lack of interaction between different communities that utilize multimaterial joining technologies.
- List the challenges and barriers.

2:15pm-2:30pm **Break**

2:30pm-3:30pm **Breakout Session: Actions** **Two concurrent sessions**

- For the opportunities and barriers identified in the first two breakout sessions, what actions should be taken to overcome the identified barriers?
- List the actions to be taken.

3:30pm-3:45pm **Break**

3:45pm-4:00pm **Breakout Session Reports & Closing Remarks** **Stephen Sikirica**

4:00pm **Adjourn**

Speaker Biographies

Dr. Ed Herderick joined the Edison Welding Institute in the fall of 2010. Since joining, he has been working in the materials group, providing expertise on ceramics and fundamental materials science to clients in such industries as consumer electronics, aerospace, and energy production. Ed has industry experience working on advanced aerospace composite materials. He also has experience working with novel nanostructures for electronic applications. Ed has several peer-reviewed publications in the journals Nanotechnology and Applied Physics Letters. He has also given presentations at numerous technical conferences both domestic and internationally including MS&T 2008 where he won the Diamond Award for Graduate Excellence in Materials Science from the American Ceramic Society. Ed received his BS, MS, and PhD degrees from The Ohio State University, all in Materials Science & Engineering.

Dr. Glenn S. Daehn is a Professor in the Department of Materials Science and Engineering at The Ohio State University and is designated the Mars G. Fontana Professor of Metallurgical Engineering and the Executive Director of the Honda-Ohio State Partnership Program. His research group has been actively developing electromagnetic metal forming technologies for the past 20 years. He is one of the founding members and Chair of the International Impulse Forming Group (i2fg.org). He also has research interests in the high temperature creep deformation of solids, the reactive processing of ceramics to create ceramic-metal composites. A long-term theme in his work is using unusual mechanics or reactions to open new paths to manufacturing processes. Professor Daehn has been engaged in promoting the development of materials science courses in high schools and he served as the founding director of the Ohio Manufacturing Institute. He was named a National Young Investigator by NSF, was recipient of the Hardy Medal of TMS (1992), and named a Fellow of ASM in 2010. Daehn's academic training includes a BS from Northwestern University (1983), and MS and PhD degrees from Stanford University (1987), all in Materials Science and Engineering.

Dr. Zhili Feng is the Group Leader for Materials Joining and NDE in the Materials Science and Technology Division, Oak Ridge National Laboratory. He received his Ph.D. degree in Welding Engineering from The Ohio State University. He specializes in thermal-mechanical-metallurgical behaviors of materials during welding and joining. A fellow of American Welding Society, he is recognized for his research and development in computational weld mechanics and materials, modeling of welding processes and performances of welded structures, friction stir welding and processing, novel solid-state joining processes of dissimilar metals, and characterization of materials behavior by advanced neutron and synchrotron scattering. Dr. Feng has broad interactions with the industry in the area of materials joining, and extensive experience in application of analysis results to solve industry problems. Many of his R&D programs came from automotive, aerospace, nuclear, petrochemical and power generation industries, as well as from government agencies such as DOE, DOD, NASA, NSF and NIST. Dr. Feng has over 100 publications related to materials joining and allied technologies.

Dr. Jerry Gould is a Technology Leader covering the resistance and solid-state welding activities conducted at EWI. A strong area of this activity has been resistance spot welding, particularly of coated and advanced high-strength steels. These studies have included detailed process investigations, weldability of various materials, and weldability of various stack-up and geometry configurations. Resistance welding of aluminum has also

become a focus of this activity. Other areas of research include seam welding, projection welding, flash welding, resistance butt welding, and friction welding. Of note has been with respect to work on honeycomb panel construction. This has included the specific resistance welding processes involved, as well as work with a range of high-temperature materials. Since 1985, Jerry has been on the senior technical staff concentrating on the forge welding activities at EWI. Prior to this, he was senior research engineer at the Inland Steel Company Research Laboratory. His major area of expertise is resistance spot welding of sheet steels. Activities in this area have included thermal modeling, weld solidification, electrode deterioration, weldability of various materials, and process kinetics. Additional areas of interest are mechanical properties of welded joints, design of experiments, quality management, and resistance welding equipment design. Gould received a BS in Mechanical Engineering from California State Polytechnic University, and ME and PhD degrees from Carnegie Mellon University in Metallurgical Engineering & Materials Science. Gould is a Fellow of the American Welding Society, receiving the James A. Lincoln Gold Metal Award in 1995.