Introduction to EWI Forming Center

Oct. 21, 2013

Hyunok Kim, Ph.D.
Technical Director
EWI Forming Center

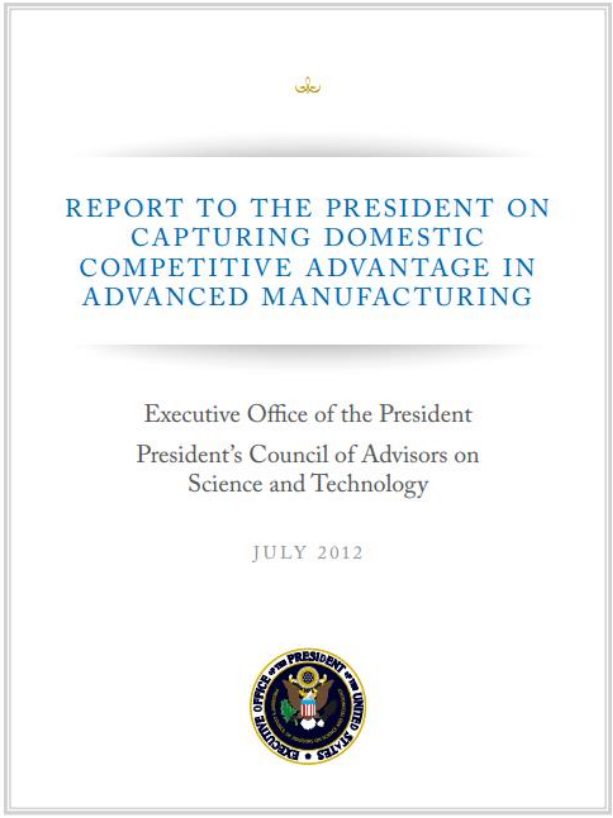
EWI Forming Center

EWI®
We Manufacture Innovation

National Priority for Forming Technology

President's Council of Advisors on Science and Technology

"Advanced Forming and Joining Technologies are recognized as the



11th Top Cross-Cutting Technologies pivotal in enabling U.S. manufacturing competitiveness"

EWI Forming Center

EWI
We Manufacture Innovation

Why an EWI Forming Center?

- **Forming is used by most EWI member companies.**
- **There are many technical challenges facing industry.**
- **There is no existing organization like EWI that provides forming technology development services in the U.S.**
- **Forming technology will benefit from many existing EWI strengths: modeling, materials, NDE, laser processing, etc.**
- **We want to grow EWI Forming Center to become the forming technology leader in the western hemisphere.**

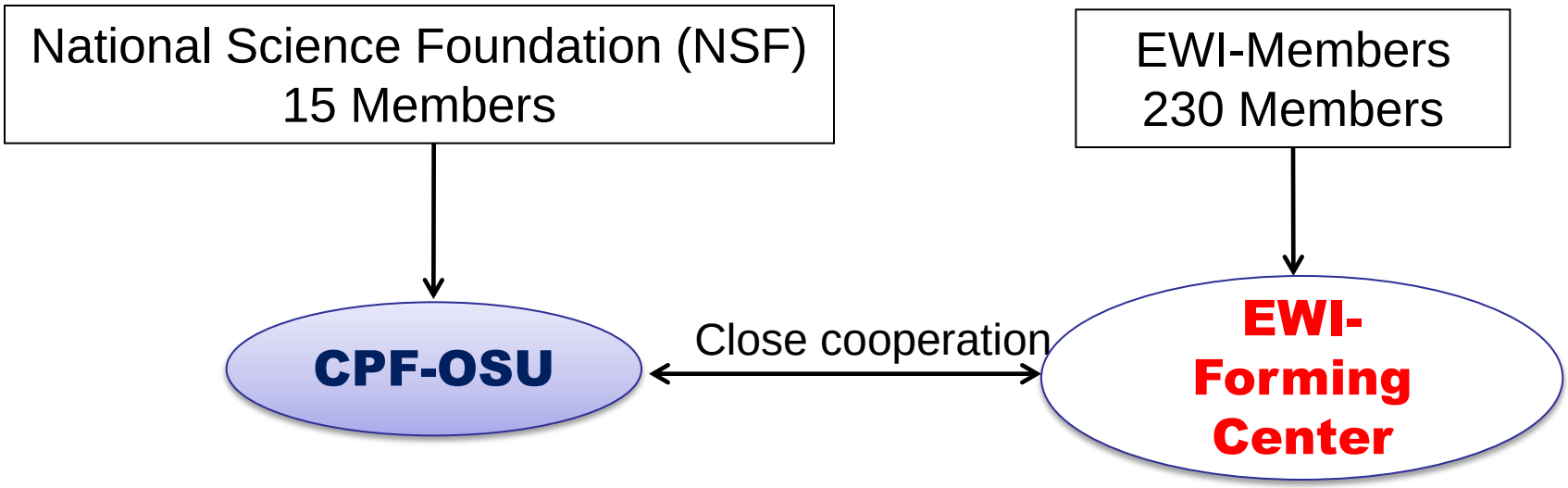
Mission of EWI-FC

- **To develop and advance innovative forming processes, tooling, and equipment**
- **To provide a forming technology knowledge base to industry and government**
- **To bolster fundamental research of forming through cooperation with Ohio State University's Center for Precision Forming (OSU-CPF)**

Collaboration with OSU-CPF

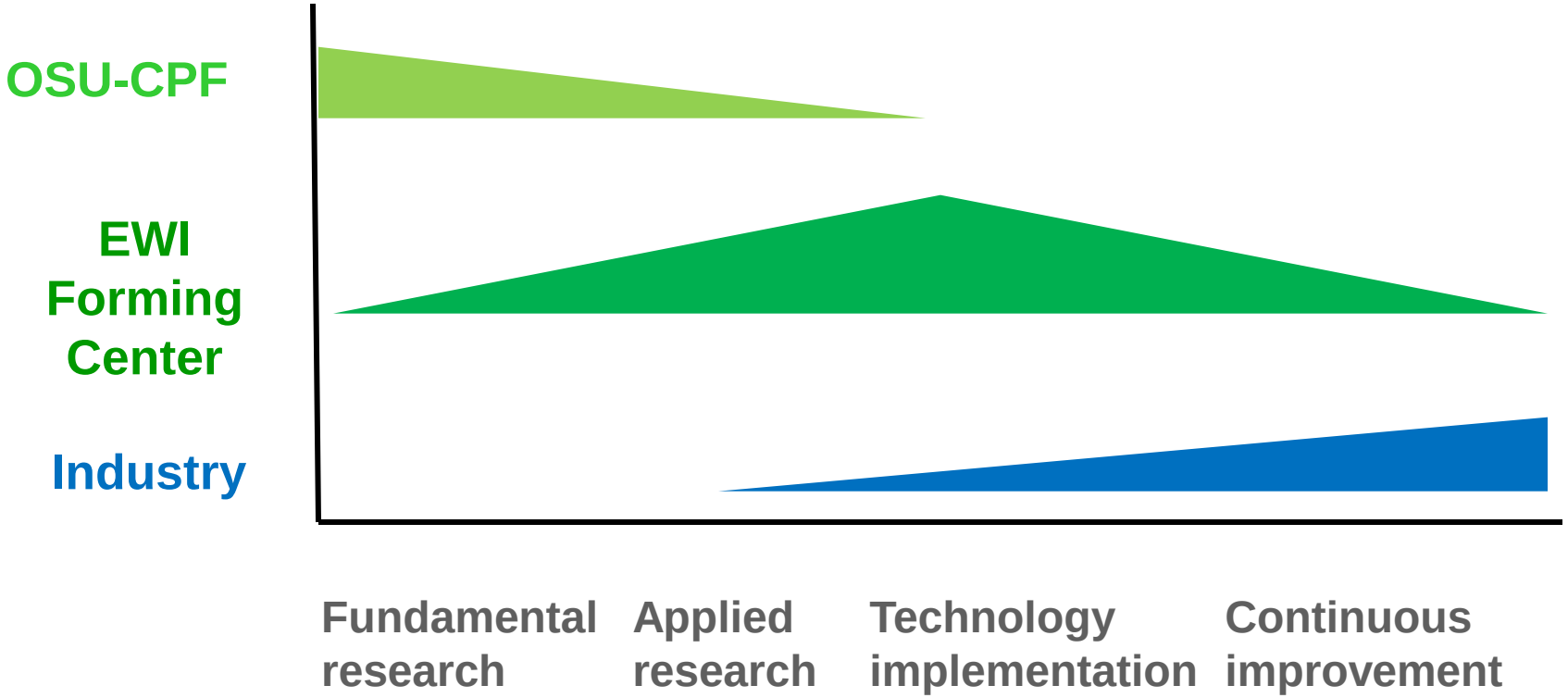
EWI-Forming Center and
Ohio State University – Center for Precision Forming

Meeting the challenge thru collaboration



Cooperation: Seamless Roles

EWI-Forming Center and OSU-CPF Activities in R&D



EWI Forming Center

EWI
We Manufacture Innovation

Engaging the Forming Community

"Friends of the EWI Forming Center"

- **Intent:**
  - **A no-fee activity** to encourage customer to participate in the forming center's activities and to incubate project work and an understanding of market needs

- **Benefits:**
  - **Information**:
    - Semi-annual workshops to share non-proprietary research results
    - Communications with customers through the website *http://ewi.org/ewi-forming-center*
    - Quarterly E-mail newsletters of the Center's activities and articles
  - **Technical resource** through contracted project work or Joint Industry Project
  - **Business partnership** by promoting business networks and developing government proposals on mutually interesting topics

- **Friend Required Activities:**
  - Participating in semi-annual workshops
  - Completing a periodic technical survey from the Center

Past Workshops of EWI Forming Center

- The center's inaugural event and first joint workshop with OSU-CPF was held at EWI on November 14, 2012 (70 industry attendees).
- The second workshop was held with 80 industry attendees on March 21, 2013.
- The third workshop will be held at EWI on Nov. 14, 2013.

Agenda for Upcoming Workshop

THURSDAY, NOVEMBER 14, 2013

EVENTS

Advanced Metal Forming Technology Workshop: Final Agenda

WEDNESDAY, NOVEMBER 13, 2013

5:00 – 7:00 pm	Reception at EWI

THURSDAY, NOVEMBER 14, 2013

8:00 – 8:30 am	Doors open at 8:00 am / Registration / Continental Breakfast
8:30 – 8:40 am	Welcome / Objectives Ron Brown, EWI Forming Center
8:40 – 9:00 am	R&D Update in Metal Forming at EWI-FC Hyunok Kim, EWI Forming Center
9:00 – 9:20 am	R&D Update at OSU Center for Precision Forming Taylan Altan, OSU-CPF
9:20 – 9:50 am	Research Initiatives and Challenges of the North American Forging Industry Carola Sekreter, Forging Industry Association
9:50 – 10:20 am	Coffee Break / Networking / Exhibits
10:20 – 10:50 am	Servo Drive Press Applications for Forming Light Metals Shrini Patil, Aida-America
10:50 – 11:20 am	Auto Steel Partnership R&D Activities on AHSS Stamping D.J. Zhou, Chrysler Group LLC
11:20 – 11:50 am	Forming of Al Alloys in the Automotive Industry Jack Clark, Novelis Global Research & Technology Center
11:50 – 12:20 pm	Advanced High Strength Steels for Automotive Application Dean Kanelos, Nucor Steel Supplier
12:20 – 1:15 pm	Lunch / Networking / Exhibits
1:15 – 1:45 pm	Sheet Metal Forming in the Automotive Industry – Issues and Future Outlook Jim Dykeman, Honda R&D
1:45 – 4:00 pm	Panel Discussion – Panel members from Aida-America, Chrysler, Dayton Progress, EWI-FC, Forging Industry Association, Honda, Hyson Products, Nucor Steel, Novelis, and Shiloh Moderator: Taylan Altan
4:00 – 4:30 pm	Tour of EWI (optional) / Exhibits

CONTACT US

For more information please contact Rebecca Gurk at rgurk@ewi.org or 614.688.5164.

EWI Forming Center

CPF Center for Precision Forming

EWI Forming Center

EWI®

We Manufacture Innovation

New Training Class on Sheet Metal Forming (Nov. 12-13)

TRAINING

Fundamentals and Applications of Sheet Metal Forming

OVERVIEW

This two-day course gives attendees a detailed introduction to sheet metal forming and its applications. It provides a solid background on the issues that influence day-to-day forming processing. The course is for those who are new to sheet metal forming or need to become more proficient in forming terminology, material properties, equipment, procedures development and problem troubleshooting. Class includes lecture, course materials, lab demonstrations (as applicable) and certificate of completion.

COURSE OUTLINE

Day 1: Fundamentals in Sheet Metal Forming

- Introduction of Sheet Metal Forming
- Formability and Testing Methods
- Tribology (Friction, Lubrication and Wear)
- Press Equipment (Mechanical, Hydraulic, and Servo-Drive Press)
- Cushion Systems
- Sensors (for Force, Displacement, Safety, Metal Flow and Lubrication)
- Tool Materials, Treatments, and Coatings
- Blanking and Trimming
- Bending, Flanging and Hemming
- Drawing Round and Rectangular Parts
- Failures (Wrinkling, Necking, Fracture, and Springback)

Day 2: Applications of Sheet Metal Forming

- Forming Process Modeling and Simulations
- Forming of Advanced High Strength Steels (AHSS)
- Hot Forming and Hot Stamping for Auto, Aero and Heavy Manufacturing
- Cold and Warm Forming of Aluminum and Magnesium Alloys
- Incremental Forming (Spinning, Flow Forming and Shear Spinning)
- Hydroforming (Sheet and Tube Hydroforming)
- Use of Servo-Drive Presses to Form AHSS and Al Alloys

EWI Forming Center

EWI

1250 Arthur E. Adams Dr.
Columbus OH 43221
614.688.5000
ewi.org

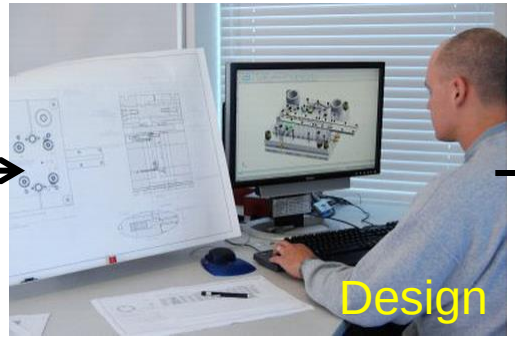
Instructors

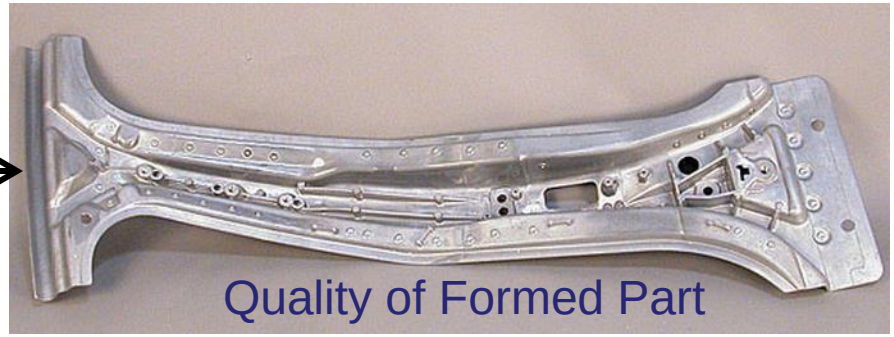
Taylan Altan is currently the Chairman of EWI Forming Center. Taylan achieved Diploma Ingenieur (Bachelor engineering degree) at Technical University Hannover (Germany) in 1962 and M.S. (1966) and Ph.D. (1966) at University of California, Berkeley. Taylan has been a professor of Industrial and Mechanical Engineering at OSU since 1986. Before coming to OSU, he was a staff member (Researcher, Research Leader, Sr. Research Leader) at Battelle Columbus Laboratories (1968-1986) and a Researcher at DuPont (1966-1968). He is a fellow member of several professional societies (CIRP, ASME, ASM International, SME) and Director of the Center for Precision Forming- CPF (an I/UCRC funded by NSF and industry) and the Engineering Research Center for Net Shape Manufacturing (ERC/NSM). Taylan authored and co-authored more than 500 technical papers and several books on topics, related to manufacturing and metal forming.

Hyunok Kim is currently the Technical Director of the EWI Forming Center. His technical expertise includes cold/hot forming technology, tribology in metal forming processes, and forming test/formability/process modeling analyses. Hyunok received his M.S. (2002) and Ph.D. (2008) in manufacturing and metal forming areas respectively at University of Michigan and the Ohio State University. Since joining EWI in 2008, he has contributed in consulting with small to large- sized metal forming companies, material suppliers, and various OEMs of automotive, heavy manufacturing and shipbuilding in various countries. In his role as a stamping council member of the Fabricators and Manufacturers (www.fmanet.org) Association in the U.S., he is also actively networking with the metal forming industry to develop practical training courses for engineers, designers and shop floor technicians. Hyunok authored and co-authored more than 30 technical papers and articles on topics, related to manufacturing and metal forming.

For information of this class, contact info@ewi.org

Research Activities: Industry Needs/Target Areas





Customer Needs

A. New materials
B. New design challenges
C. Better quality and performance
D. Reduce the manufacturing cost

Research Areas (Targets)

1. Formability & Fractures
2. Tribology (friction and wear)
3. Forming process simulations
4. Forming test and process demo
5. Novel forming processes

Research Areas and Topics (FY13-14)

1. **Formability and Fractures**
   - The stress-strain curves and forming limit diagram (FLD) data for UHSS (DP, TRIP and TWIP) and Aluminum alloys (w/ OSU-CPF)
   - Practical Evaluation of Formability and Reliable Predictions of Failures of AHSS and Al alloys (Joint Industry Project)
2. **Tribology**
   - Evaluation of lubricants with aluminum sheet metal (w/ OSU-CPF)
   - Evaluation of stamping lubricants with AHSS
3. **Forming process simulations**
   - Progress die forming of the automotive part
   - Hot forming of IN-718 material and Manganese-Boron steels
   - Hot forming of an heavy truck axle housing
   - Thermal forming of a thick plate for ship hull structure
   - Hot forming of the structure of a powered industry truck

Research Areas and Topics

4. **Forming test and process demo**
   - Hot forming test of Inconel-718 and Ti-6 sheet metals
   - Round and rectangular cup draw testing with AHSS and aluminum sheet metals
   - Developing hole-punching and expansion testing capabilities

5. **Novel forming processes and allied technologies**
   - Ultrasonic-assisted forming technology (Stamping and Hot Forging)
   - Tailor property hot stamping process using a laser tempering
   - Advanced thermal forming of a thick plate for the ship structure
   - Non-Destructive Evaluation (NDE) of trimmed-edge quality

Forming Equipment Capabilities at EWI-FC

160-ton Minster Tranemo Press
(Operating at EWI since Sept. 2012)

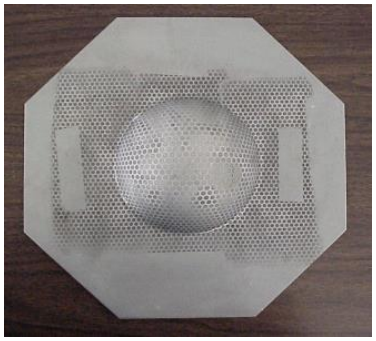
Type	Minster Tranemo DPA-160-10
Slide Force	160 metric tons (176.4 tons)
Cushion Force	100 metric tons (110.3 tons)
Eject Force	15 metric tons (16.5 tons)
Slide Speed	90 mm/s maximum (3.54 in./s)
Slide Stroke	500 mm (19.68 in.)
Platen Size	1,000 × 1,000 mm (39.37 × 39.37 in.)
Test tooling	7 different testing die sets available with the press

EWI Forming Center

EWI
We Manufacture Innovation

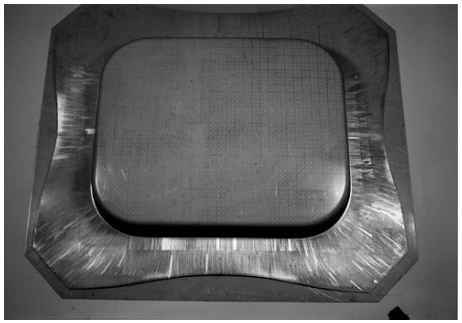
Forming Test Capabilities

- **Formability tests**
  - Tensile (up to 1000˚F) test
  - Biaxial bulge test
  - Forming limit diagram (FLD) test
  - Billet upsetting and extrusion tests
- **Friction, lubrication, and tool wear tests**
  - Strip galling test
  - Deep drawing test
  - Limiting dome height (LDH) test
  - Ironing test with heated dies
  - Double cup extrusion (DCE) test
- **Stamping tests**
  - Bending and flanging tests
  - Rectangular deep drawing test
  - Springback tests



Biaxial Bulge Tested Sample (12 × 12 in.)

Deep Drawn Sample (6-in. bottom dia. × 3.5-in. depth)



Rectangular Drawn Sample (20- × 18- × 2-in. depth)

DCE Tested Sample (1-in. dia. × 2.5-in. height)

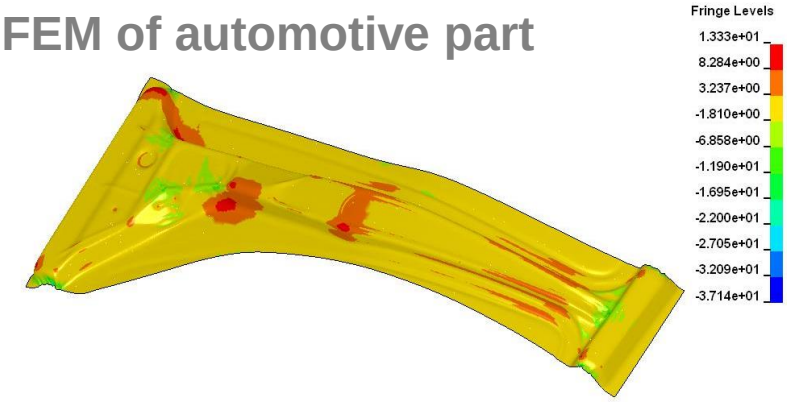
EWI Forming Center

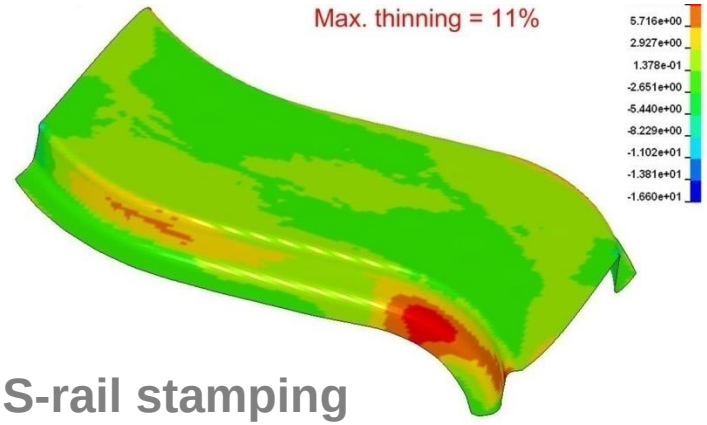
EWI
We Manufacture Innovation

Simulation Capabilities

- **Process Simulations**
  - **Sheet Metal Forming**
    - Springback / Failures
    - Tool stress and wear
    - Tool design and process optimization
  - **Bulk Metal Forming (Forging)**
    - Die stress and temperature distribution
    - Optimized die shape
  - **FE Modeling Tools**
    - ABAQUS
    - DEFORM
    - LS-DYNA
    - PAM-STAMP

FEM of automotive part





S-rail stamping simulation

EWI Forming Center

EWI
We Manufacture Innovation

Conclusions

- **The EWI-FC is rapidly building technical capability in metal forming.**
- **The EWI-FC has been bolstering fundamental research of forming by closely collaborating with OSU-CPF.**
- **Interest and support from industry are essential for the continued growth and success of the center.**

Questions & Contact

Hyunok Kim, Ph.D.
Technical Director
EWI Forming Center
614.688.5239
hkim@ewi.org