72nd Annual Denver X-ray Conference Report

Stephanie Jennings [a)]
ICDD, Newtown Square, PA, USA
[a)]Author to whom correspondence should be addressed. Electronic mail: sjennings@icdd.com

I. FORMAT, DATES, AND ATTENDANCE

The 72nd Annual Conference on Applications of X-ray Analysis, more commonly known as the Denver X-ray Conference or DXC, was held 7–11 August 2023. The week-long conference returned to the Chicago area, visiting The Westin Chicago Lombard, Lombard, Illinois, USA. X-ray and materials scientists gathered at the conference to discuss various techniques, applications, software, instruments, and products for XRD and XRF analyss. The combination of attendees and exhibitors brought the attendance to over 375 X-ray scientists, with over 30% from outside the United States.

II. DXC WORKSHOPS

The technical program began with 16 half-day tutorial workshops held on Monday and Tuesday of conference week. Topics were categorized as either XRD, XRF, or Special Topic and focused on both beginner and advanced levels. 45 specialists were invited to participate as workshop instructors, and many provided handouts that were posted on a private website for attendees only. Topics included:

What the APS Upgrade will bring to X-ray Analysis – Parts I and II	Advanced Topics in GSAS-II
Cultural Heritage	Texture
Basic to Intermediate XRD	Micro XRF
Basic XRF	XRF of Layered Structures
In situ Battery Measurements	XRD Methods for Complex Multi-Phase Identification
Quantitative XRF	How to Get the Best from Your Handheld XRF Spectrometer
Sample Preparation for XRF	XRF Trace Analysis
Intro to GSAS-II	

III. PLENARY SESSION AND DXC AWARDS

The Plenary Session, *Energy Storage*, was held on Wednesday morning as the opening session for the oral talks that were presented during the next three days of conference week. **Scott Misture**, Alfred University, chaired the plenary, which began with an awards presentation.

The Barrett Award, given biennially to recognize the outstanding contributions to the field of powder diffraction, was presented to **Ashfia Huq** of Sandia National Laboratories, USA. Dr. Huq received the award for her commitment to and leadership in the advancement of spallation neutron powder diffraction, and for her service to the neutron powder diffraction community (Figure 1).

The Jenkins Award, given biennially to recognize scientists who exhibit lifetime achievement in the advancement of the use of X-rays in materials analysis, was presented to **Tim Elam** of University of Washington, USA. Dr. Elam received the award for his contributions to X-ray fluorescence spectrometry in the development of instrumentation and methods of X-ray analyses in challenging environments, including the PIXL micro-XRF spectrometer on the Mars rover Perseverance. The award also recognized his many contributions to educating and teaching others in the field of X-ray spectroscopy (Figure 2.).

Also presented during the DXC Plenary Session was the 2022 ICDD Hanawalt Award, recognizing distinguished, recent work in the field of powder diffraction. The Hanawalt Award was presented to **Karena Chapman** of Stony Brook University, USA. Dr. Chapman received the award for her contributions in developing X-ray diffraction capabilities in the study of challenging materials problems in sustainable energy and environmental remediation Figure 3.

Eight outstanding young scientists received the 2023 Robert L. Snyder Student Grant Award. The awardees and the works they presented at the conference were:

Dana Alramahi, Illinois Institute of Technology, USA, *High Entropy Oxide Tungsten Bronzes as Anodes for Lithium Ion Batteries*, XRD Poster Session

Karen Castañeda Marin, Illinois Institute of Technology, USA, *Synthesis and Characterization of MoP Nanoparticles Used Aas a Catalyst in CO_2 Reduction Reaction*, XRF Poster Session

Sven Hampel, Clausthal University of Technology, Germany, *Successful Picoliter Printing of 65 Elements for TXRF Analysis and Related Methods,* XRF Poster Session & *Investigation of the Genesis of Spinel Solid Solutions in Recycling Slags*, Energy Storage and Harvesting Session & *Determination of Diffusion Coefficients of Vanadium Inside Polymer Electrolyte Membranes,* General XRF Session

Benjamin Hulbert, University of Illinois at Urbana Champaign, USA, *Specimen Displacement Correction for Powder X-ray Diffraction in Debye-Scherrer Geometry with a Flat Area Detector*, General XRD Session & *Crystal Structure Solution and Thermal Expansions of $CaZr_4(PO_4)_6$ and $SrZr_4(PO_4)_6$,* XRD Poster Session

Hao Lin, Illinois Institute of Technology, USA, *Exploring the Structural Evolution in Li-Rich Layered Materials via Operando XRD*, XRD Poster Session

Benard Lawer Patawah, Illinois Institute of Technology, USA, *XAS Study Local Atomic Environment Mn-Edge in MnO_xGO Nanocomposites as Air-Cathode for Metal-Air Battery Application*, XRF Poster Session

Himihami Mudiyanselage Senevirathna, Illinois Institute of Technology, USA, *In Situ EXAFS Study on Pd @ $Ni(OH)_2$ during Electrocatalytic CO_2 Reduction Reaction*, XRF Poster Session

Philipp Ziegler, TU Wien, Austria, *Tackling Low Z Element Quantification with TXRF*, XRF Poster Session

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Figure 1. (Left to Right) Barrett Award Winner Ashfia Huq of Sandia National Laboratories, USA, pictured with Conal Murray, IBM T.J. Watson Research Center, Yorktown Heights, USA.

Following the awards presentation, the plenary session continued with three fascinating talks by keynote speakers **Y. Shirley Meng**, Argonne National Laboratory, USA, **Karena Chapman**, Stony Brook University, USA, and **Will Chueh**, Stanford University, USA. Dr. Meng presented the talk, *Designing Better Materials for Future Batteries.* Next was Dr. Chapman's presentation on, *X-ray Visions: Operando Insights into Functional Energy Materials.* Lastly, Dr. Chueh presented on *Dynamic Electrochemical Phenomena at the Mesoscale*. The session was very well attended and offered great insight on future advancements in science and technology Figure 5.

IV. SPECIAL SESSIONS

From Wednesday afternoon through Friday morning, 16 half-day oral sessions were held. Over 100 presentations were organized in the oral sessions, with 30 presentations given by invited speakers, experts in their respective fields. Topics included:

New Developments in XRD & XRF	General XRF
Instrumentation	Industrial Applications of XRF
Imaging	General XRD
Stress and Texture Analysis	Quantitative Analysis of XRF
Trace Analysis	Energy Storage and Harvesting
Machine Learning Techniques in X-ray	Cultural Heritage
Analysis – Parts I & II	Applications of Rietveld Analysis
Synchrotron Applications in XRD	Micro XRF and Synchrotron
Industrial Applications of XRD	Applications

V. POSTER SESSIONS

Posters were presented on Monday and Tuesday evenings during the XRD and XRF poster sessions. Two E-poster stations were also setup in the exhibit hall. Attendees were

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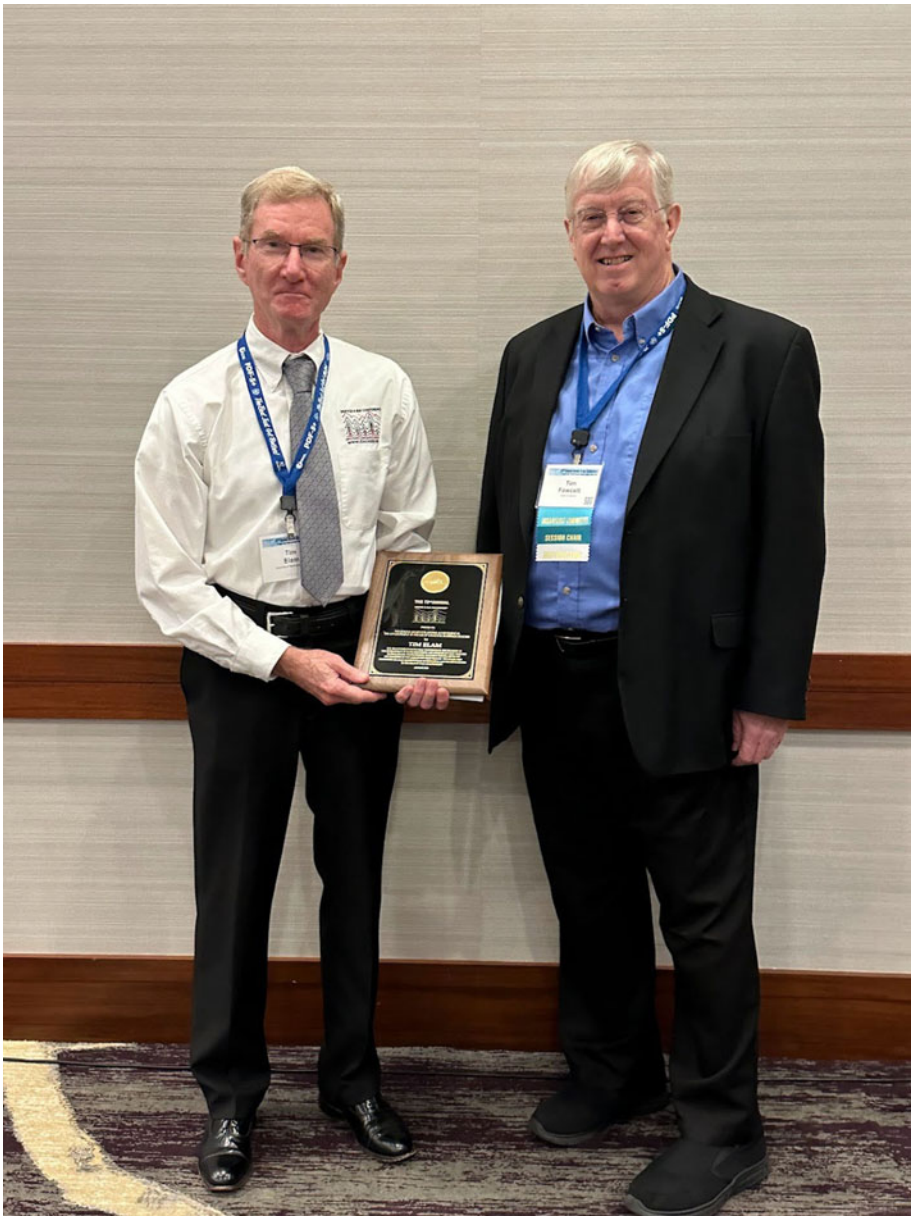

Figure 2. (L-R) Jenkins Award Winner Tim Elam of University of Washington, USA, pictured with Tim Fawcett, ICDD, Newtown Square, USA.

given the opportunity to preview electronic copies of the posters at the E-poster stations or through the mobile app, Whova. Respected judges chose the best posters, and the competition was strong.

Ultimately, the following presenters were named winners:

A. XRD best poster awards

James Kaduk*, T. Ens, N. Boaz, North Central College, USA

T. Blanton, A. Dosen, ICDD, USA, for their work:

Crystal Structures of Large-Volume Commercial Pharmaceuticals

Benjamin S. Hulbert*, J.E. Brodecki, W.M. Kriven, University of Illinois at Urbana-Champaign, USA, for their work:

Crystal Structure Solution and Thermal Expansions of $CaZr_4(PO_4)_6$ and $SrZr_4(PO_4)_6$

Dana Alramahi*, O. Marques, C. Segre, Illinois Institute of Technology, USA, for their work:

High Entropy Oxide Tungsten Bronzes as Anodes for Lithium Ion Batteries

Figure 6.

B. XRF best poster awards

Ruthmara Corzo*, NIST, USA

J. Stallworth, T. Gluodenis, Lincoln University, USA, for their work:

Elemental Characterization of 3D-printed Polymers Using Micro X-ray Fluorescence Spectrometry for Forensic Applications

Sven Hampel*, F. Sand, U.E.A. Fittschen, Clausthal University of Technology, Germany

G. Pepponi, Fondazione Bruno Kessler, Italy, for their work:

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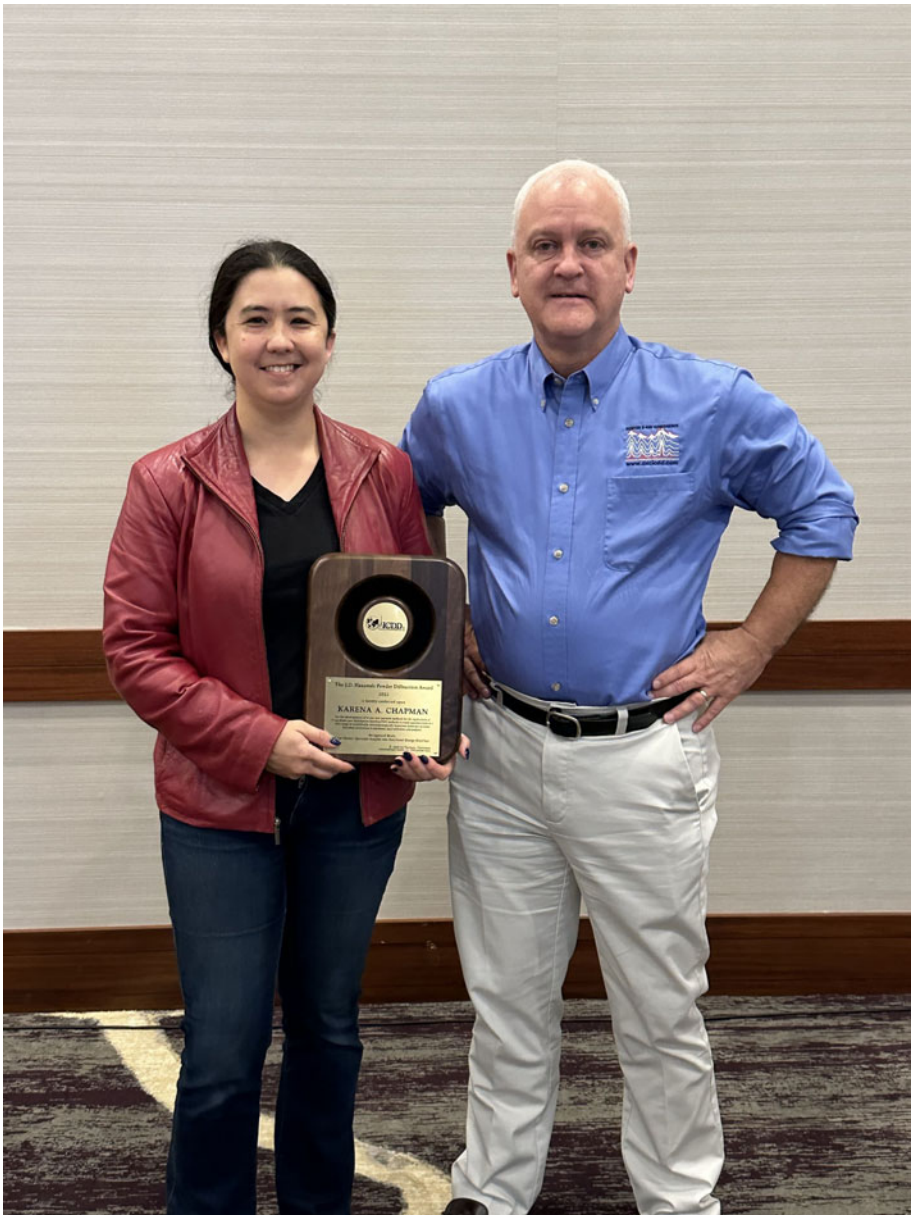

Figure 3. (L-R) Hanawalt Award Winner Karena Chapman of Stony Brook University, USA, pictured with Tom Blanton, ICDD, Newtown Square, USA.

Successful Picoliter Printing of 65 Elements for TXRF Analysis and Related Methods

Karen A. Castañeda*, I. Senevirathna, C. Segre, M. Asadi, Illinois Institute of Technology, USA, for their work:

Synthesis and Characterization of MoP Nanoparticles Used as a Catalyst in CO2 Reduction Reaction

Figure 7.

We would like to thank two of our exhibitors for sponsoring additional Best Poster Awards during the XRF Poster Session, Amptek, Inc. and XOS.

C. Amptek award for best student XRF poster

Alyssa Tovar*, M. Schmeling, Loyola University Chicago, USA, for their work:

Environmental Sampling of Chicago Industrial Corridors

D. XOS innovation award™:

1st Place:

Donald Windover*, NIST, USA

K.J. Kim, KRISS, Korea, for their work:

Thickness Monitoring Using X-ray Fluorescence in Hafnia Films

Runner Up:

Sven Hampel*, F. Sand, U.E.A. Fittschen, Clausthal University of Technology, Germany

G. Pepponi, Fondazione Bruno Kessler, Italy, for their work:

Successful Picoliter Printing of 65 Elements for TXRF Analysis and Related Methods

VI. EXHIBITS AND SPONSORSHIPS

The exhibit hall accommodated 36 companies with displays of products and services for the X-ray community. See

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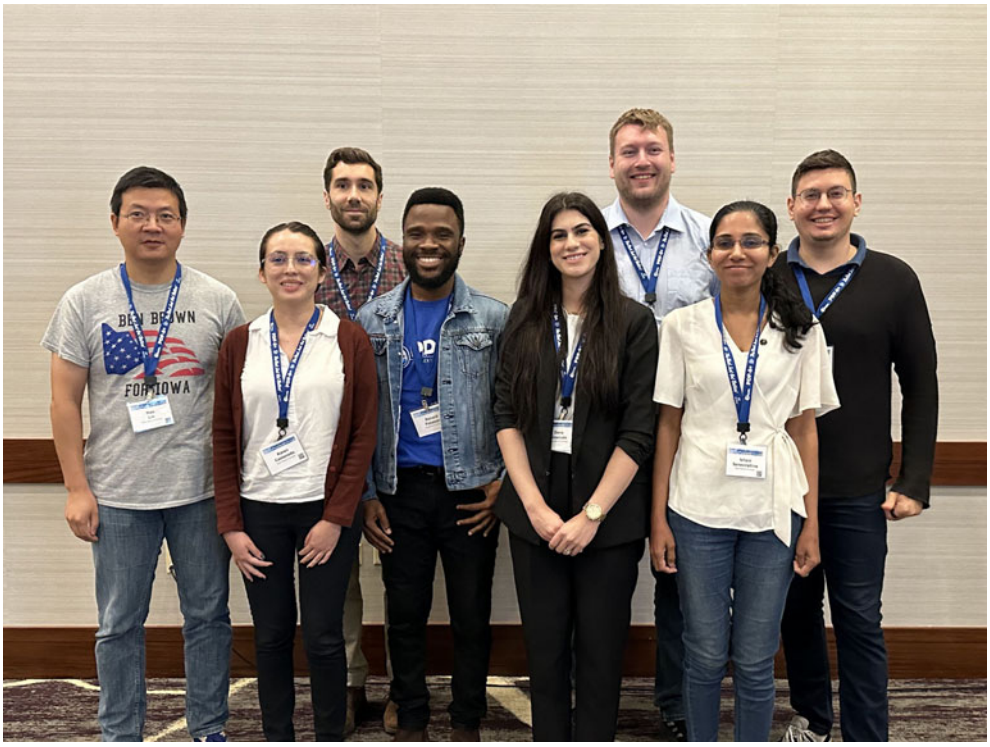

Figure 4. 2023 Robert L. Snyder Student Grant Award Winners.

a complete listing of exhibitors and their product descriptions in the 2023 Onsite Program located at www.dxcicdd.com. The Denver X-ray Conference is very appreciative of their support this year.

Many of the exhibitors also supported the conference as sponsors, including Amptek, Inc., Anton Paar, Bruker, ICDD, KETEK GmbH, Materials Data, Petrick GmbH, Rigaku Americas, Xenocs, and XOS. The generosity of our sponsors helps to keep attendee costs low and the quality of the conference high. We are grateful for their support!

VII. WEBSITE AND PROCEEDINGS

To view the complete DXC Program, please visit the 'Past DXC' page of the conference website, located under the 'About DXC' tab at www.dxcicdd.com. The conference

Figure 5. 2023 Plenary Speakers (L-R) – Karena Chapman, Y. Shirley Meng, Scott Misture (Session Chair), and Will Chueh.

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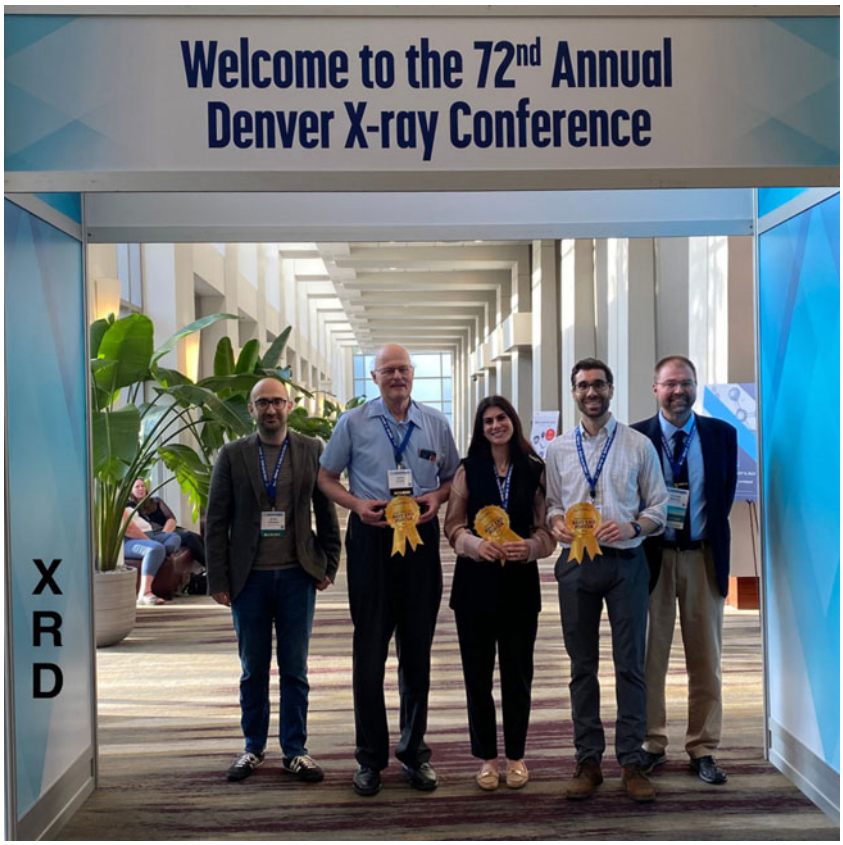

Figure 6. XRD Poster Session Award Winners (L-R) – Ercan Cakmak (Poster Judge), James Kaduk, Dana Alramahi, Benjamin S. Hulbert, and Tom Watkins (Poster Judge).

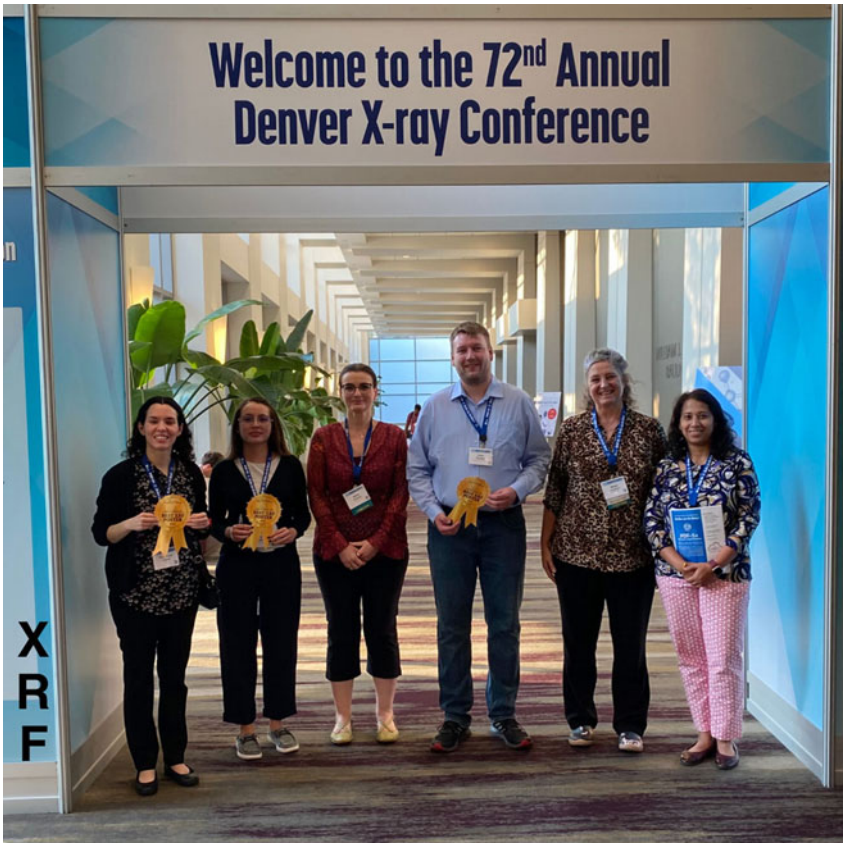

Figure 7. XRF Poster Session Award Winners (L-R) – Ruthmara Corzo, Karen A. Castañeda, Diane Eichert (Poster Judge), Sven Hampel, Maggi Loubser (Poster Judge), and Poulami Dutta (Poster Judge).

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proceedings, *Advances in X-ray Analysis*, Volume 67, will be published in the summer of 2024. Select papers will also be published in *Powder Diffraction* Journal. Please also visit the 'Resources' tab on the ICDD website www.icdd.com, for free full access to manuscripts published in Volumes 40 through 66 of *Advances in X-ray Analysis*.

VIII. THANK YOU

The Conference Services team at ICDD would like to thank the many people who volunteered their time and efforts to organize this event. Members of the DXC Organizing Committee, Session Chairs, Workshop Instructors, Invited and Contributed Speakers, and Exhibitors all played a role in bringing the community together again. Special thanks also to the attendees who joined us as well. The success of the event is attributed to each and every individual who participated, and we send our genuine thanks to all of you!

IX. 2024 MEETING

Save the date! In 2024, DXC will return to Colorado, 5-9 August, at, The Westin Westminster, Westminster, Colorado, USA.