



## **Conference & Workshop**

**東京 (Tokyo, Japan)**

**26 - 29 September 2023**



TOKYO GEIDAI



**東京文化財研究所**

Tokyo National Research Institute for Cultural Properties

Organized by Conservation Science Laboratory, Tokyo University of the Arts (Geidai) and the Tokyo National Research Institute for Cultural Properties (Tobunken)

Editors: Boris Pretzel and Masahiko Tsukada

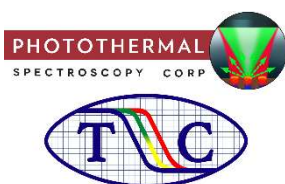
# Sponsorship Acknowledgements

IRUG would like to acknowledge the generous support it has received for IRUG15 from its industrial sponsors.

## Silver level sponsor



## Bronze level sponsors



We would also like to acknowledge Thermo Fisher Scientific and Bruker for the support they are providing for the reflectance spectroscopy workshop (27 September 2023)

Boris Pretzel

Masahiko Tsukada

IRUG 15 Conference Organisers  
Conservation Science Laboratory Tokyo University of the Arts  
and  
Tokyo National Research Centre for Cultural Properties

## Conference schedule (summary)

Date/Time†	26-Sep	27-Sep	28-Sep	29-Sep
08:00	Registration			
08:15				
08:30				
08:50	Welcome	08:50 start	08:50 start	08:50 start
09:00		Posters 7 - 9	Oral 12	Oral 24
09:15	Oral 1	Posters 10-12	Oral 13	Oral 25
09:30	Oral 2	Poster 13	Oral 14	Oral 26
09:45	Oral 3	Sponsors talk	Q&A	Q&A
10:00	Q&A	(09:35 - 10:20)	Oral 15	T/C/P/S
10:15	T/C/P/S	T/C/P/S	Oral 16	
10:30			Q&A	Oral 27
10:45	keynote		T/C/P/S	Oral 28
11:00		sponsors		Oral 29
11:15			Oral 17	Q&A
11:30		Workshop	Oral 18	Oral 30
11:45	Q&A	10:20 /	Oral 19	Oral 31
12:00		visits	Oral 20	Oral 32
12:15		Tea	Q&A	Q&A
12:30	Lunch	ceremonies		
12:45	posters	Sake tasting		
13:00	sponsors		Lunch	Lunch
13:15			posters	posters
13:30			sponsors	sponsors
13:45	Oral 4			
14:00	Oral 5		Oral 21	Oral 33
14:15	Oral 6		Oral 22	Oral 34
14:30	Q&A		Oral 23	Oral 35
14:45	Oral 7		Q&A	Q&A
15:00	Oral 8			
15:15	Oral 9		T/C/P/S	T/C/P/S
15:30	Q&A			
15:45	T/C/P/S		Tours	IRUG
16:00	Posters 1-3			Summary
16:15	Posters 4-6			closing
16:30	Oral 10			<b>Close</b>
16:45	Oral 11			
17:00	Q&A			
17:15	Sponsors			
17:30			<b>Close day 3</b>	
17:45				
18:00			Sake tasting	
18:15				
18:30	<b>Close day 1</b>	<b>Close day 2</b>		

†

Times are approximate - see detailed schedule for more info

## Tuesday 26 September

08:00	Registration			
	<b>Name</b>	<b>Organisation</b>	<b>Title</b>	
08:50	Welcome	Welcome statements from Tobunken and Geidai and introduction to conference		
09:00				
	Session chair: Professor Boris Pretzel, Geidai			
09:15	Oral 1	Dr Marcello Picollo	IFAC CNR, Florence, IT	Total Reflectance FT-IR Spectra: Impact of the Support on Paint Layer Analysis
09:30	Oral 2	Dr Arthur A. McClelland	Harvard University, US	Using Principal Component Analysis and Specular Reflection FTIR to Model Chemical Tests and Fiber ID...
09:45	Oral 3	Professor Lijiang Yang	Peking University, Beijing, CN	Computational chemistry simulations of molecular structures in different ageing silk textiles using ATR-FTIR
10:00	Q&A	Q&A Papers 1 -3		
10:15	T/C/P/S	Break for tea / coffee / posters / sponsors		
10:30				
10:45	Keynote	Professor James de Haseth	University of Georgia, Athens, Georgia, US	Infrared reflection spectrometries
11:00				
11:15				
11:30				
11:45	Q&A	Q&A for keynote talk		
12:00	Lunch / Posters / sponsors	Lunch break with time for posters and sponsors		
12:15				
12:30				
12:45				
13:00				
13:30	Oral 4	Ms Catherine Matsen	Winterthur Museum, Garden & Library, US	The Need for Speed: a success story of couture, exhibition and catalog deadlines, and ATR/DRIFTS
13:45	Oral 5	Dr Elizabeth Carter	Sydney Analytical, University of Sydney, AU	Raising of the Sun and the Moon: the Sydney Opera House tapestries
14:00	Oral 6	Dr Ashley Freeman	LA County Museum of Art (LACMA), US	Maria Kipp and Dorothy Wright Liebes: exploring the use of metallic threads in mid-20th century textiles

	Name	Organisation	Title
14:15	Q&A	Q&A for papers 4 – 6	
	Session chair: Professor Masahiko Tsukada, Geidai		
14:30	Oral 7	Drs Abed Haddad and Corina Rogge	Museum of Modern Art (MoMA) and The Menil Collection, US Is there an International Klein Pink?
14:45	Oral 8	Joan M. Walker	National Gallery of Art, Washington DC, US ER-FTIR spectroscopy of coated silver gelatin photographs: applications to the works of Dorothea Lange
15:00	Oral 9	Ekaterina Morozova (virtual)	The State Research Institute for Restoration, Moscow, RU Natural and synthetic organic pigments in the palette of Nicholas and Svyatoslav Roerich
15:15	Q&A	Q&A for papers 7 – 9	
15:30	T/C/P/S	Break for tea / coffee / posters / sponsors	
15:45			
	Quickfire poster presentations 1 - selected posters only		
16:00	Poster 1	Dr Lynn Brostoff	Private conservation scientist, US Identification of colorants in an 18th century Torii Kiyonaga hashira-e
16:05	Poster 2	Dr Catherine Cooper	National Center for Preservation Technology and Training, LA, US Testing the sustainability of washing and reusing conservation cleaning sponges
16:10	Poster 3	Dr Abed Haddad	Museum of Modern Art (MoMA) New York, US Rainbow treasures: multi-analytical characterization of Ronan Superfine Japan Colors
16:15	Poster 4	Clare Kim	Australian Museum, Sydney, AU Investigation of unknown substances from entomology collection using ATR-FTIR spectroscopy
16:20	Poster 5	Na Ra Lee	National Research Institute of Cultural Heritage, KR Application of handheld Raman spectroscopy for pigment ID of a large Buddhist painting in Janggoksa Temple
16:25	Poster 6	Dr Yufang Li	Northwest University, Xi'an, CN Infrared spectrum identification of liquor residues in ancient China
	Late afternoon paper session		
16:30	Oral 10	Dr Qian Cheng	China National Centre for Archaeology, CN Colours transferred along the Silk Road: the manufacture of glass beads from Qiemo cemetery, Xinjiang Region, during first millennium CE...
16:45	Oral 11	Dr Louisa Campbell	University of Glasgow, UK Polychromy and portable Raman spectroscopy: identifying degraded pigments on roman sculpture
17:00	Q&A	Q&A for papers 10 – 11	
17:15	Sponsors	Time for delegates to interact with sponsors and/or look at posters	
17:30			
17:45			
18:00			
18:15			
18:30	Close day 1		
	Ueno Park tour and orientation		

08:50	start	Name	Organisation	Title
Quickfire Poster presentations 2 (selected posters only)				
Session chair: Dr Suzan de Groot, Rijksdienst voor Cultureel Erfgoed (RCE)				
09:00	Poster 7	Dr Lamprini Malletzidou	Adv. Materials & Devices lab., Aristotle University, GR	Assessing the effects of a fire protocol on wall painting mock-ups
09:05	Poster 8	Shinnosuke Ono	Toyo Institute of Art & Design, JP	Prediction model for paper degradation using FT-IR spectra
09:10	Poster 9	Dr Corina E. Rogge	The Menil Collection, Texas, US	Blurred lines: issues distinguishing between alkyds and oils
09:15	Poster 10	Seka Seneviratne	Grimwade Centre, University of Melbourne, AU	Preliminary FTIR microscopic analyses coupled with SEM-EDX for the identification of microbes on lab. made modern paintings from Thailand
09:20	Poster 11	Dr Gregory Dale Smith	Indianapolis Museum of Art, US	Curious corrosion at Centre College: chalconatronite, antlerite, and tenorite on bronzes in rural Kentucky
09:25	Poster 12	Dr W. Vetter (Prof. Schreiner)	Akademie der Bildenden Künste, AT	Manuscript illumination at the court of Emperor Maximilian I (1459-1519): A multianalytical study using ER-FTIR, XRF, and Hyperspectral Imaging
09:30	Poster 13	Dr Jia Yu	National Research Institute of Cultural Heritage, KR	FTIR as a method to estimate the combustion atmosphere of ancient cremated human bone: Korean cremation burials in the Baekje period
Silver level sponsor's talk - Thermo Fisher Scientific				
09:35	Sponsors talk	Stephan Woods	Thermo Fisher Scientific	Vibrations throughout history- Insights into the past by vibrational spectroscopy
10:20	T/C/P/S	Break for tea / coffee / posters / sponsors		
10:35	sponsors	Sponsors / Posters		
11:20	Workshop / visits	Workshop / visits		
11:30				
12:00				
14:00				

Tea Ceremony group 1



## Thursday 28 September

08:50	start	<b>Name</b>	<b>Organisation</b>	<b>Title</b>
Session chair: Dr Greg Smith, Indianapolis Museum of Art				
09:00	Oral 12	Michael Doutre	Getty Conservation Institute, US	An FTIR-ATR Survey of German Democratic Republic Plastics in Design
09:15	Oral 13	Dr Suzan de Groot	Rijksdienst voor Cultureel Erfgoed (RCE), NL	On the road with a portable Raman system: Identifying plastics in Dutch ` collections
09:30	Oral 14	Dr Eleonora Del Federico (virtual)	Pratt Institute, New York, US	Non-invasive multi-analytical studies of early Licio Isolani paintings and fiberglass polyester resin sculptures
09:45	Q&A	Q&A for papers 12 – 14		
10:00	Oral 15	Dr Tai-Sheng Yeh	Meiho University, TW	Application of open-source software for spectra analysis of pigments
10:15	Oral 16	Mike Lo	Photothermal Spectroscopy Group	Sub-micron infrared analysis of painting cross-section for accurate identification of paint layer compositions
10:30	Q&A	Q&A for papers 15 - 16 (10 minutes)		
10:40	T/C/P/S	Break for tea / coffee / posters / sponsors		
Session chair: Herant Khanjian, GCI				
11:10	Oral 17	Nasim Koohkesh	University of Melbourne, AU	Application of r-FTIR in pigment identification of white and green pigments in a Persian illuminated manuscript
11:25	Oral 18	Stephanie Barnes	Canadian Conservation Institute (CCI), Ottawa, CA	Non-invasive study of handpainted illustrations from an early 19th century manuscript using ER-FTIR, Raman and other methods...
11:40	Oral 19	Jennifer Giaccaï	National Museum of Asian Art, Smithsonian, Washington DC, US	Infrared and Raman analysis of black East Asian printing inks
11:55	Oral 20	Professor Manfred Schreiner	Akademie der Bildenden Künste, AT	Multidisciplinary studies of medieval manuscripts
12:10	Q&A	Q&A for papers 17 - 20 (20 MINUTES)		
12:30	Lunch / Posters / sponsors Lunch break with time for posters and sponsors			
14:00				

	Name		Organisation	Title
14:00	Oral 21	Luís Manuel de Almeida Nieto	Delft University of Technology, NL	Flexible method for feature isolation and analysis in IR reflectance data for pigment and binder identification
14:15	Oral 22	Dr Gianluca Pastorelli	National Gallery of Denmark, DK	Combining multiple NUV-MIR spectral unmixing techniques for identifying mixtures of colorants in art and cultural heritage
14:30	Oral 23	Dr Celia Chari (virtual)	Harvard Art Museum, Harvard University, US	Non-invasive Identification of pigments in Indian manuscripts using principal component analysis and specular reflection FTIR data
14:45	Q&A	Q&A session for papers 21- 23		
15:00	T/C/P/S	Break for tea / coffee / posters / sponsors		
15:30	Visits	Visit around Tobunken facilities (prebooked groups only)		
17:30	Close day 3			
17:45				
18:00	Sake tasting	Prebooked only	Session 3 18:00 - 20:00 Session 4 20:00 - 22:00	

## Friday 29 September

08:50	start	Name	Organisation	Title
Session chair: Professor Manfred Schreiner, Akademie der Bildenden Künste, Wien, AT				
09:00	Oral 24	Dr Aditya Prakash Kanth	Centre for Heritage Mgmt., Ahmedabad University, IN	ATR -FTIR and μ-Raman based analysis for detection of chemical transformation in Indian wall paintings
09:15	Oral 25	Dr Shuxuan Shi	University of Science and Technology, Beijing, CN	Studies on Chinese architectural pasting ornament in the Forbidden City by Raman spectroscopy
09:30	Oral 26	Georgina Rayner and Dr Katherine Eremin (virtual)	Harvard Art Museum, Harvard University, US	Polychrome decoration on wooden Prince Shōtoku sculptures and associated miniature deities from C13th
09:45	Q&A	Q&A for papers 24 – 26		
10:00	T/C/P/S	Break for tea / coffee / posters / sponsors		
10:30	Oral 27	Celia Cramer	University of Sydney, AU	Investigating the potential of NIR spectroscopy to provenance natural history museum specimens
10:45	Oral 28	Mr An Gu	The Palace Museum, Beijing, CN	Revealing recipes of ancient Chinese lacquer process techniques by non-invasive quantitative method: near IR spectroscopy and chemometrics
11:00	Oral 29	Dr Yingchun Fu	University of Science and Technology, Beijing, CN	Quantitative study of oils in ancient lacquer objects by near-infrared spectroscopy
11:15	Q&A	Q&A for papers 27 – 29		
Session chair: Dr Marcello Picollo, IFAC-CNR				
11:30	Oral 30	Dr Flavia Fiorillo	Fitzwilliam Museum, University of Cambridge, UK	Novel insights from the study of Isaac Oliver's portrait miniatures
11:45	Oral 31	Erin Mysak and Christy Gratini	Museum of Fine Arts (MFA) Boston, US	Characterization of artists' materials from 20th century Mexican ex-voto paintings
12:00	Oral 32	Sawako Sentoku	Tokyo University of the Arts, JP	FTIR analysis of the blue restoration of cyanotypes decolorized after alkalis
12:15	Q&A	Q&A for papers 30 – 32		
12:30	Lunch / Posters / sponsors Lunch break with time for posters and sponsors			
14:00				

14:00	Oral 33	Herant Khanjian	Getty Conservation Institute, US	Analytical studies of light aged Asian lacquer boards
14:15	Oral 34	Mingrui Zhang	Zhengzhou University, Henan Province, CN	Leather deterioration: insights for the conservation of collagen-based cultural heritage
14:30	Oral 35	Dr Rebecca Ploeger	University at Buffalo (SUNY), US	The value of degraded polymers - representing degraded polymers in IRUG
14:45	Q&A	Q&A for papers 33 – 35		
15:00	T/C/P/S	Break for tea / coffee / posters / sponsors		
15:15				
15:30	IRUG	Boris Pretzel	Tokyo University of the ARts / IRUG	30 years on – IRUG in the past, present, and future
15:50	Summary	Conference summary		
16:00	closing	closing remarks and close		

16:30 **Close**

16:45

17:00

17:15

17:30

17:45

18:00

18:15

18:30

## Papers accepted for IRUG 15

Papers are listed alphabetically by presenting author. Titles are taken from IRUG15 registration information and should not be relied upon to determine academic or professional positions or qualifications. Ctrl + Click on author or title to go to the abstract.

Author(s)	Institution	Paper titles
<b>Stephanie Barnes et al</b>	Canadian Conservation Institute, Ottawa, CA	Non-invasive study of hand-painted illustrations from an early 19th century manuscript using ER-FTIR, Raman and other complementary methods – successes and challenges
<b>Dr Louisa Campbell</b>	University of Glasgow, UK	Polychromy and portable Raman spectroscopy: identifying degraded pigments on roman sculpture
<b>Dr Elizabeth Carter et al</b>	Sidney Analytical, University of Sydney	Raising of the Sun and the Moon: The Sydney Opera House Tapestries
<b>Dr Celia Chari et al (v)†</b>	Harvard Art Museum, Harvard University, US	Non-invasive identification of pigments in Indian manuscripts Using Principal Component Analysis and Specular Reflection FTIR data
<b>Dr Qian Cheng et al</b>	China National Centre for Archaeology, CN	Colours transferred along the Silk Road: slight on the manufacture of glass beads from Qiemo cemetery site, Xinjiang region, during the first millennium CE by Raman micro-spectroscopy and SEM-EDS
<b>Celia Cramer et al</b>	University of Sydney, AU	Investigating the potential of NIR spectroscopy to provenance natural history museum specimens
<b>Michael Doutre et al</b>	Getty Conservation Institute, US	An FTIR-ATR survey of German Democratic Republic plastics in design
<b>Dr Eleonora del Federico et al (v)†</b>	Pratt Institute, New York, US	Non-invasive multi-analytical studies of the early paintings and fiberglass polyester resin sculptures by artist Licio Isolani
<b>Dr Flavia Fiorillo et al</b>	Fitzwilliam Museum, University of Cambridge, UK	Novel insights from the study of Isaac Oliver's portrait miniatures
<b>Dr Ashley Freeman et al</b>	LACMA	Maria Kipp and Dorothy Wright Liebes: exploring the use of metallic threads in mid-20th century textiles
<b>Dr Yingchun Fu et al</b>	University of Science and Technology, Beijing, CN	Quantitative study of oils in ancient lacquer objects by near-infrared spectroscopy
<b>Jennifer Giaccai et al</b>	National Museum of Asian Art, Smithsonian Institution, Washington DC, US	Infrared and Raman analysis of black East Asian printing inks
<b>Dr Suzan de Groot</b>	RCE The Netherlands, NL	On the road with a portable Raman system: Identifying plastics in Dutch museum collections

Author(s)	Institution	Paper titles
<b>Mr An Gu et al</b>	The Palace Museum, Beijing, CN	Revealing the key recipes of ancient Chinese lacquer process techniques by non-invasive quantitative method: near infrared spectroscopy and chemometrics
<b>Drs Abed Hadad and Corina Rogge</b>	Museum of Modern Art (MoMA) and The Menil Collection, Texas, US	Is there an International Klein Pink?
<b>Professor James de Haseth</b>	University of Georgia and Light Light Solutions LLC, US	Keynote talk: Infrared reflection spectrometries
<b>Dr Aditya Prakash Kanth et al</b>	Centre for Heritage Management, Ahmedabad University, Gujarat, IN	ATR -FTIR and $\mu$ -Raman based analysis for detection of chemical transformation in Indian wall paintings
<b>Herant Khanjian et al</b>	Getty Conservation Institute, US	Analytical studies of light aged Asian lacquer boards
<b>Nasim Koohkesh et al</b>	University of Melbourne, AU	Application of r-FTIR in pigment identification of white and green pigments in a Persian illuminated manuscript
<b>Mike Lo et al</b>	Photothermal Spectroscopy Group, US	Sub-micron infrared analysis of painting cross-section for accurate identification of paint layer compositions
<b>Ms Catherine Matsen et al</b>	Winterthur Museum, Garden & Library, US	The Need for Speed: a success story of couture, exhibition and catalog deadlines, and ATR/diffuse reflectance IR
<b>Dr Arthur A McClelland et al</b>	Harvard University, US	Using principal component analysis and specular reflection FTIR for paper fiber identification
<b>Ekaterina Morozova (v)†</b>	The State Research Institute for Restoration, Moscow, RU	Natural and synthetic organic pigments in the palette of Nicholas and Svyatoslav Roerich
<b>Erin Mysak and Christy Gratini</b>	Museum of Fine Arts Boston, US	Characterization of artists' materials from 20th century Mexican ex-voto paintings
<b>Luís Manuel de Almeida Nieto et al</b>	Delft University of Technology, NL	Flexible method for feature isolation and analysis in infrared reflectance data for pigment and binder identification
<b>Dr Gianluca Pastorelli et al</b>	National Gallery of Denmark, DK	Combining multiple NUV-MIR spectral unmixing techniques for identifying mixtures of colorants in art and cultural heritage
<b>Dr Marcello Picollo et al</b>	IFAC CNR, IT	Total reflectance FT-IR Spectra: Impact of the support on paint layer analysis
<b>Professor Boris Pretzel</b>	Tokyo University of the Arts / IRUG	30 years on: IRUG in the past, present, and future
<b>Dr Rebecca Ploeger et al</b>	University at Buffalo (SUNY), US	The value of degraded polymers - representing degraded polymers in IRUG
<b>Georgina Rayner et al (v)†</b>	Harvard Art Museum, Harvard University, US	Polychrome decoration on wooden Prince Shōtoku sculptures and associated miniature deities from the 13th century
<b>Professor Manfred Schreiner et al</b>	Akademie der Bildenden Künste, AT	Multidisciplinary studies of medieval manuscripts

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<b>Joan M. Walker et al</b>	National Gallery of Art, Washington, US	ER-FTIR spectroscopy of coated silver gelatin photographs: applications to the works of Dorothea Lange
<b>Stephan Woods</b>	Thermo Fisher Scientific (Silver level sponsor's talk)	Vibrations throughout history- Insights into the past by vibrational spectroscopy
<b>Professor Lijiang Yang et al</b>	Peking University, Beijing, CN	Computational chemistry simulations in the deep understanding of molecular structures in different ageing silk textiles using ATR-FTIR spectroscopy
<b>Dr Tai-Sheng Yeh et al</b>	Meiho University, TW	Application of open-source software for spectra analysis of pigments
<b>Mingrui Zhang et al</b>	Zhengzhou University, Henan Province, CN	Leather deterioration: insights for the conservation of cultural heritage

† (v) signifies a presentation given virtually

## Posters accepted for IRUG15

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Author(s)	Institution	Poster titles
<b>Dr Lynn Brostoff et al</b>	Private conservation scientist, US	Identification of Colorants in an 18th Century Torii Kiyonaga hashira-e
<b>Dr Catherine Cooper et al</b>	National Center for Preservation Technology and Training (NCPTT), LA, US	Testing the sustainability of washing and reusing conservation cleaning sponges
<b>Dr Abed Haddad</b>	Museum of Modern Art (MoMA), US	Rainbow treasures: multi-analytical characterization of Ronan Superfine Japan Colors
<b>Clare Kim</b>	Australian Museum, Sydney, AU	Investigation of unknown substances from Entomology collection using ATR-FTIR spectroscopy.
<b>Na Ra Lee et al</b>	National Research Institute of Cultural Heritage, KR	Application of handheld Raman spectroscopy for pigment identification of a large Buddhist painting in Janggoksa Temple, South Korea
<b>Dr Yufang Li et al</b>	Northwest University, Xi'an, CN	Infrared spectrum identification of liquor residues in ancient China
<b>Dr Lamprini Malletzidou</b>	Laboratory of Advanced Materials & Devices, Aristotle University of Thessaloniki, GR	Assessing the effects of a fire protocol on wall painting mock-Ups
<b>Mariko Nakao et al</b>	Archaeological Institute of Kashihara, Nara, JP	An analysis of Lacquer layers adhering to excavated potteries using FTIR
<b>Masayoshi Okuyama et al</b>	Archaeological Institute of Kashihara, Nara, JP	Research on textile material from Kofun period (4th century to the middle of the 6th century) in Japan - a study of cultural properties using a FT-IR photoacoustic spectroscopy
<b>Shinnosuke Ono</b>	Toyo Institute of Art & Design, JP	Prediction model for paper degradation using FT-IR spectra and its explainability
<b>Dr Corina E. Rogge et al</b>	The Menil Collection, Texas, US	Blurred lines: issues distinguishing between alkyds and oils
<b>Seka Seneviratne et al</b>	Grimwade Centre for Cultural Material Conservation, Melbourne University, AU	Preliminary FTIR microscopic analyses coupled with SEM-EDX for the identification of microbes on laboratory made modern paintings from Thailand
<b>Dr Gregory Dale Smith et al</b>	Indianapolis Museum of Art, US	Curious corrosion at Centre College: chalconatronite, antlerite, and tenorite on bronze sculptures in a rural Kentucky setting
<b>Dr W. Vetter et al (Professor Schreiner)‡</b>	Akademie der Bedlenen Künste, AT	Manuscript illumination at the court of Emperor Maximilian I (1459-1519): a multianalytical study using ER-FTIR, XRF, and hyperspectral imaging
<b>Dr Jia Yu et al</b>	National Research Institute of Cultural Heritage, KR	FTIR as a necessary method to estimate the combustion atmosphere of ancient cremated human bones: A case of cremation burials in the Baekje period, Korea

‡ presented by a colleague.