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von

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Crystallography for Art: Contribution of X-ray powder diffractometry

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Vortragssaal EA1 (Erdgeschoss)

Crystallography for Art - contribution of X-ray powder diffractometry

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Abstract

X-ray fluorescence (XRF) and X-ray powder diffraction (XRPD) are important and well-established methods in the field of heritage science. The XRF technique, usually applied as the first step of an investigation, provides information about the elemental composition of a sample, whereas XRPD enables identification of its phase composition. Neither chemical analysis alone nor more sophisticated techniques which provide information on elemental composition, can determine if white inlays on ancient brooches are limestone (calcite) or shell (aragonite), since both consist chemically of calcium carbonate. With certain pigments: malachite $\text{CuCO}_3 \cdot \text{Cu(OH)}_2$ and verdigris $\text{Cu(CH}_3\text{COO)}_2 \cdot n\text{Cu(OH)}_2 \cdot m\text{H}_2\text{O}$, lead tin yellow type I (Pb_2SnO_4) and type II (PbSnO_3) or chrome oxide green (Cr_2O_3) and viridian green ($\text{Cr}_2\text{O}_3 \cdot \text{H}_2\text{O}$) the situation is similar.

Thanks to XRPD it was also found that the white pigment in Van Gogh's painting *A spring landscape near Arles* is the synthetic pigment rutile (a polymorph of TiO_2). This pigment was used in art only after 1938, so, XRPD measurement clearly showed that the work was not executed by Van Gogh who died already in 1890 [1].

XRPD studies provide support for archaeologists, art historians, and conservators as they continue to expand their knowledge about heritage objects housed in museums and private collections. Information about the composition of heritage objects facilitates the understanding of historical events, manufacturing techniques, and provenance. The obtained results can also assist in the formation of better preventive conservation strategies for valuable ancient collections.

The Structure-oriented Powder Diffractometry group at the Faculty of Chemistry, Jagiellonian University, is involved in XRPD investigations of metallic archaeological objects and painting materials used by famous artists [2,3]. During the lecture various case studies involving the use of XRPD will be presented with the aim of illustrating some of the possibilities and limitations encountered when analyzing the objects of cultural heritage.

References

- [1] J. Sirois, 'X-ray Diffraction at CCI, Canadian Conservation Institute – CCI in Action'. CCI Newsletter 8, October 1991, 4-6.
- [2] M. Wołoszyn, E. M. Nosek, J. Stępiński, A. Rafalska-Łasocha, W. Łasocha, E. Bielańska, 'The seals from Czermno (Cherven owns, eastern Poland) – chemical analysis and metallurgical examination', *Archeologia Polski*, LX:2015, 123-152
- [3] A. Rafalska-Łasocha, M. Grzesiak-Nowak, D. Sarkowicz, W. Łasocha, 'The use of XRPD for the investigation of historic pigments and painting materials in works by Henryk Siemiradzki', *J. Anal. At. Spectrom.*, 2015,**30**, 751-758.

CVs

Dr. Alicja Rafalska-Łasocha

- Senior scientist at Faculty of Chemistry Jagiellonian University in Krakow
- Main research interests: the use of X-ray diffraction methods to the study of works of art – history of science
- Co-organizer and secretary of the International Union of Crystallography Commission on "Crystallography in Art and Cultural Heritage"
- Organizer and member of the scientific committees of international conferences devoted to scientific investigations of cultural heritage materials
- Member of the Commission on the History of Science, Polish Academy of Arts and Sciences
- Curator of numerous exhibitions on life and work of Maria Skłodowska-Curie and life and work of Karol Olszewski, <http://www.biurokarier.chemia.uj.edu.pl/wystawy>
- In 2014 – the International Year of Crystallography – curator and organizer of a travelling exhibition "In the unusual world of crystals", http://www2.chemia.uj.edu.pl/kryształy_wystawa/
- Author of the book "Marie Skłodowska-Curie and her contacts with the Krakow's scientific circles".
- Author or co-author of over 70 scientific papers and over 170 contributions to scientific conferences.

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- Main research interests:
 - Structural investigations on the basis of powder diffraction data.
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 - Synthesis of new isopolyoxocompounds of Mo(VI) and V(V) and of aliphatic and aromatic amines.
 - Synthesis of new peroxomolybdates, peroxovanadates and peroxotungstates
- Scientific career:
 - 2007 professor of chemistry, Jagiellonian University
 - 2005- Head of XRD and Thermoanalysis Laboratory, ICSC PAS
 - DSc - habilitation (1996) Faculty of Chemistry, Jagiellonian University, "Applications of new X-ray powder diffraction methods in investigations of fibrillar molybdates and selected halogen compounds of metals".
 - PhD (1986) Faculty of Chemistry, Jagiellonian University, "Synthesis and crystal structure studies of selected isopolymolybdates".
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- Fellowships:
 - 1986-1987 research associate, Michigan State University
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