

**FA2-MS03-P01**

**Quantitative Phase Analysis of Model Painting Layers: A comparison of X-ray Micro Diffraction with Conventional Transmission and Reflection Geometries.** Petr Bezdička<sup>a</sup>, Eva Kotulanová<sup>a</sup>, Mariana Klementová<sup>b</sup>. <sup>a</sup>*Institute of Inorganic Chemistry of the ASCR, v.v.i., c.p. 1001, Husinec-Rez, 25068, Czech Republic & Academy of Fine Arts in Prague, ALMA laboratory, U Akademie 4, 170 22, Prague 7, Czech Republic.* <sup>b</sup>*Institute of Inorganic Chemistry of the ASCR, v.v.i., c.p. 1001, Husinec-Rez, 25068, Czech Republic.* E-mail: [petrb@iic.cas.cz](mailto:petrb@iic.cas.cz)

Laboratory X-ray micro-diffraction ( $\mu$ XRD) is becoming more widely applied to inorganic phase analysis of artworks samples and there is a growing demand to give relevant answers to questions about the detection limits or whether the quantitative phase analysis (QPA) can also be performed using the micro-diffraction setup.

To be able to give such answers a comparison of the micro-diffraction setup with the most commonly set-ups (reflection and transmission) in the quantitative phase analysis, binary and ternary mixtures of azurite, malachite, calcite and quartz in known ratios were prepared and analyzed. Quantitative phase analysis of all experimental data was done using Rietveld method. It was found that the accuracy of results of quantitative analysis highly depends on the sample preparation. The most accurate results were obtained in transmission geometry.

Model paint layers that simulate typical paint layers of artworks were also prepared. Fragments of these model layers were analyzed by  $\mu$ XRD. The success of micro-diffraction analysis depends markedly on the homogeneity of analyzed layers because of smaller irradiated area. The accuracy of X-ray micro-diffraction on fragments falls in between that of the other two methods performed on powder mixtures. Detection limits of micro-diffraction were studied and it was revealed that approximately 5 weight percent of phase in a mixture is needed both for reliable qualitative and quantitative analysis.

**Keywords: micro-diffraction; quantitative phase analysis; art-works**

**FA2-MS03-P02**

**Mineralogical and Art-historic Traits in Investigation of 'Anonymous' Paintings.** David Hradil<sup>a,b</sup>, Janka Hradilová<sup>b</sup>, Petr Bezdička<sup>a,b</sup>, Jitka Vlčková<sup>c,b</sup>. <sup>a</sup>*Institute of Inorganic Chemistry of the AS CR, v.v.i., Řež.* <sup>b</sup>*Academy of Fine Arts in Prague.* <sup>c</sup>*National Historical Institute, Prague Central Workplace, Czech Republic.* E-mail: [hradil@iic.cas.cz](mailto:hradil@iic.cas.cz)

The application of modern microanalytical methods in the materials analyses of paintings produce a lot of data with the aim to resolve questions of the painting authenticity, dating or provenance. To be successful, the multidisciplinary approach is needed in fact, combining knowledge

of materials, their sources and use, the painting technique and artistic and art-historic evidence. The fingerprinting is necessary instead of excessive collection of data. From the methodological point of view, the mineralogical approach within any provenance study of Old Masters pigments should be specifically underlined. According to our experience the laboratory powder X-ray microdiffraction is a very effective tool for direct phase analysis of microsamples containing crystal constituents with no need of their pre-treatment. For example, the detailed description of different clay minerals structures in earthy pigments is crucial for specifying their natural source and can only be done by the X-ray diffraction methods. When combining the stylistic and material traits we can therefore conclude, for example, that the association of chlorite and dolomite in preparation layers is typical for North Italian paintings, smectites comes more frequently from Mediterranean while kaolinite together with illite are usually related to Mid-European sources. The presence of gibbsite in red clay-based grounds for gilding could indicate either the admixture of bauxite or, more probably, the use of red organic lake precipitated on gibbsite. Red organic lakes as well as cinnabar were added to improve the red colour in the case when the actual content of natural Fe oxides was low. Thus the results of mineralogical and crystallographic analyses contribute significantly not only to the materials provenance determination, but also to the more precise description of the painting technique and its development in the history.

**Keywords: materials microanalysis; microdiffraction; historical pigments**

**FA2-MS03-P03**

**Practical Realization of Moroccan Geometric Pattern.** Youssef Aboufadi<sup>a</sup>, Jamal Benatia<sup>a</sup>, Abdelaziz Jali<sup>a</sup>, My Ahmed Elidrissi Raghni<sup>a</sup>, Abdelmalek Thalal<sup>a</sup>. <sup>a</sup>*Department of Physics, LSM, Faculty of Sciences-Semlalia-Marrakech-Morocco.* E-mail: [fadil\\_youssef@hotmail.com](mailto:fadil_youssef@hotmail.com)

Two types of Moroccan ornamental art: are The first type is the geometric patterns called "Tastir" occur in rich profusion throughout Moroccan art. Another distinct plane pattern type perfected is the arabesque. This comprises curvilinear elements resembling leafed and floral forms called "Taouriq" and Tachjir. In this presentation we are only interesting in the plane ornamental art, particularly in the geometric drawing or "Tastir". We describe the methods of construction of the geometric patterns encountered in the Islamic art. We focus on the Moroccan method which has the particularity to respect scrupulously the rules which were adopted by the master craftsmen "Maâlam" and handed over to their disciples.

Several authors have published large collections of Islamic patterns. They focus their work on classification, analysis of these patterns. The insights offered by all of them are interesting and valuable but they don't explain how did the Islamic patterns evolve from the simple to the complex. Our purpose is to understand the algorithm used by designers and express the empirical method into mathematical model.