ABSTRACT

Surprisingly, applied mineralogy plays an important role in the forensic science field. It is the mineralogical phases which exist in many kinds of materials and traces but also the mineralogical analysis procedures which are often used in the field of so called trace evidence. For purposes of this study, 4 important fields of forensic microanalysis were chosen. These are those fields in which applied mineralogy is applied and which characterize the width and heterogeneity of the concerned area.

Powder X-ray microdiffraction plays quite an important and irreplaceable role not only in the direct phase analysis of substances in mixtures. The author designed, tested and introduced a set for centration and direct check of the analysed surface during micro-diffraction analysis and also experimentally optimised sensing parameters for the different system configuration. A possibility to calculate the size of the nanoparticles (more precisely the size of a mono crystal domain) was tested. XRD methods application allows refining organic analysis for example in the case of new synthetic drugs. Micro diffraction was also used for the first complex phase analysis of colour layers of the altar in the chapel in the castle of Křivoklát (dated 1480 – 1490).

Forensic analysis of soil phases used to be, in the Czech forensic and expert practice, carried out in a quite simple way. The author has gradually introduced a complex system which processes all available information from the provided sample including biology analyses and anthropogenic phases analyses (fragments of construction material, glass, slag, etc.). The implemented complex system enables maximum information from diverse substances that are present in soil to be obtained. Based on the tests carried out, geographic information systems (GIS) containing topographical, geological and pedological information was implemented. Currently, a system of automatic mineralogy analysis is being introduced. This system was modified, within the project of the ICP and the Tescan company (VG20102015065), for direct analysis of untreated grains with a topographic surface. Testing of the new SW, analysis parameters, changes and classification databases was executed on real samples with very good results both in the tests of measurements reproducibility and their sensitivity. The automatic analysis is a suitable supplement to the whole complex system of forensic soil analysis.

Post-blast residues analysis is a very complicated task in a highly contaminated heterogeneous mixture at a scene of explosion. That is why attention was paid to a detailed study of relevant particles morphology, sampling techniques and testing of available concentration and separation methods. Characterization of relicts of main possible improvised explosives, especially concerning possible non-stoichiometric components ratio, was carried out using available analytical techniques. All results obtained, including the so called explosive parameters, which have not been examined so far, are recorded in a programmed application which serves the needs of special units of the Czech Army and the Police of the Czech Republic and other, even foreign, specialized forces.

Colour layer complex analysis means a very wide area which spreads from tool paints, construction paints across car paints to colour layers on objects of art. For examination of material on objects of art, a procedure has been implemented in the expert practice, which starts with non destructive methods (multispectral and X-ray imaging, mobile XRD and Raman spectrometry) and stretches to a collection of micro samples and detailed examination of all pigment and accompanying phases and binders. After presence of atypical micro phases had been proved, the orthogonal TOF-SIMS FIB technique was tested. For the purposes of counterfeits identification, especially of those of modern art, a database of available paint pigments is being created in cooperation with the National Gallery, a study of "colour palette" of important modern Czech authors is being carried out. All data obtained are recorded in newly programmed and specially secured database applications.