X-RAY DIFFRACTION ANALYSIS IN THE FORENSIC SCIENCE LABORATORY OF STUTTGART, GERMANY - THE LAST RESORT IN MANY CRIMINAL CASES –

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In our forensic science laboratory, material analyses have been particularly affected by two developments over the past decade: The substantial increase of the importance of material evidence in the German criminal justice system, as well as the increase in the variability and quantity of industrially produced materials. These factors have required forensic science analysis to refine and develop versatile techniques that provide reliable, definite and accurate results, and give additional information about the chemical and physical properties of the materials.

One of these techniques, X-ray diffraction, is especially significant for the analysis of solid materials. The unique character of the diffraction patterns of crystallized material, the capability to distinguish between elements and their oxides, and the possibility to identify chemical compounds, polymorphic forms, and mixed crystals are the crucial advantages of X-ray diffraction methods. These are often the only methods that allow a further differentiation of materials under laboratory conditions. Smears, minute contact traces, small sample quantities or tiny sample areas can be successfully analyzed as well as large quantities of materials. The X-ray diffraction examinations are non-destructive, and therefore leave the original specimen intact and available for further analytical study, if necessary.

The examples I will present include comparative and reconstructive investigations, as well as the identification of unknown samples. In our laboratory we analyze all kinds of polycrystalline substances or specimens with crystalline components, because in a criminal case any type of specimen may turn out to be of forensic interest. These materials are e.g. paints (from automobiles, buildings, tools), building materials, minerals, ceramics, asbestos, metals, alloys, explosives, gemstones, soils, extender and impurities of drugs and abrasives. The applied preparation techniques, the selected diffraction method, and the used strategies of measurement depend on the forensic nature of the criminal case, as well as on the type, quantity and consistency of the suspected specimen, and the involved trace carrier. Accordingly, specimens are either examined undisturbed on the trace carrier, or removed, separated under microscopic control, and prepared using specially selected techniques. The sample holders are chosen based on their suitability in the use of micro X-ray fluorescence analysis in addition to X-ray diffraction, and are modified to suit the strategy of measurement. The samples are analyzed either in a transmission or reflection mode with a D 500 Bragg-Brentano diffractometer or with a GADDS microdiffractometer based on Debye-Scherrer geometry with devices for fixed, scanning, oscillating or rotating samples.