CROSS-SECTION-PREPARATION OF PAINTING- AND ICON- SAMPLES BY MEANS OF MICROTOMY AND MICROSCOPY

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Besides the non-destructive techniques of artwork examination such as X-ray Fluorescence Spectrometry (XRF), Raman Spectroscopy or laser-induced breakdown spectroscopy (LIBS), in some certain cases it is still necessary to obtain a high quality cross section from the artwork for further microscopical analysis. These cross-sections can be obtained by cryo-breaking, grinding and polishing, milling or microtomy. In the following, a short overview about principles, feasibilities and limitations of microtomy is given.

Mechanically, the workings of microtomy is shaving or chipping. A huge range of different microtomes like rotary-microtomes, sledge-microtomes, cryo-microtomes or ultra-microtomes is available. The procedure is nearly the same: The sample is fixed mechanically in a special kind of object-clamp or embedded in an embedding medium like methylmethacrylate or paraffin. Alternatively, samples can be fixed by freezing in water or specific cryo-embedding solutions. Finally, the prepared sample is sectioned with a microtome knife. This knife can be made of steel, tungsten carbide, glass or diamond. The thickness of the produced shavings reaches from < 100 nm (ultra-microtome) to > 1 mm (sledge microtome). The shavings are collected from the knife with a brush or forceps. These results can finally be examined by transmitted light- or infrared microscopy. The block-face of the sectioned sample is suitable for incident light microscopy or scanning electron microscopy (SEM).

Because of the non-shavable layers, like the gesso of an icon, the production of thin sections is hardly possible with rotary- or sledge microtomes. Only ultramicrotomes with a feed < 100 nm are able to produce real ultra-thin-sections. Rotary microtomes with a feed > 0,5 µm can be used for surface preparations of the block face. This surface quality is often good enough for layer or microstructure measurements.

Very often, the preparation before microtomy, like the choice of a suitable embedding medium or object holder is much more complicated and time consuming than the sectioning itself. Especially in case of artwork preparation, we have to solve several problems: In case of chemical analysis we have to avoid any influence from an

embedding medium to the sample. The know-how about the chemical components of the embedding solutions and their possible interaction with structures of the sample is of vital importance. The mechanical clamping is aggravated through very small sample sizes. Here, special object-holders from the electron-microscopy preparation can be adapted.

If only a very small splinter of a lacquer or paint sample is prepared, the handling has to be done under stereomicroscopic controlling. The long working distance of the lenses allows the user to manipulate their sample in a comfortable way. Especially for target preparations into a sample, a macroscopical controlling during the whole preparation process is evident. In general, stereomicroscopes are adapted directly to the microtome. This allows, to section accurately into a smallest spot of interest. Layer measurements and some structure analyses on the thin section or block face can be executed by light microscopy. Lots of different contrast methods like dark field-, polarisation-, fluorescence-, phase- or interference- contrast enables the distinct visualization of similar structures inside a sample.

Summing up we can say, cross sectioning allows getting a real image of the microstructures inside a sample. Optimal sectioning parameter guarantees a mostly artefact-free preparation.