ESRF	**Experiment title:** COSMETIC RECIPES AND MAKE-UP MANUFACTURING IN ANCIENT EGYPT REVEALED BY SYNCHROTRON X-RAY POWDER DIFFRACTION	**Experiment number**: CH727
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Names and affiliations of applicants (* indicates experimentalists):

Walter Philippe
Laboratoire de Recherche des Musees de France, CNRS
6, rue des Pyramides
75 041 Paris cedex 1
Martinetto Pauline, LRMF and ESRF
Ungar Tamas, Inst. for General Physics, Budapest
Dooryhee Eric, ESRF
Anne Michel, laboratoire de cristallographie, CNRS Grenoble

Report:

In a previous work (P. Martinetto et al.), a large number of cosmetics used in Ancient Egypt and conserved in Le Louvre museum have been analysed. The study reveals the great variety of compositions using lead compounds and an advanced know-how in chemical synthesis. This shows that 4000 years ago, people already wanted more from their cosmetics than simply highlighting the eyes. The study has been prolonged into the analysis of the Bragg line profiles in relation with the microstructure of some minerals (size and distortions of the grains).

The analysis of the peak profile of archaeological galena (PbS) was compared with that of a geological galena powder mined in the United States, which had been hand-ground with a pestle and mortar, then passed through a 63-125µm mesh. Figure 1 shows the integral width β of the broadened profiles, corrected for the instrumental contribution, on a Williamson-Hall diagram. The hkl anisotropy of the integral width β could be explained by the presence of a strain field associated with dislocations, and is being modelled by introducing a contrast factor which depends both on hkl and on the elastic constants of the material (Klimanek, Kuzel, 1988; Ungar, Borbély, 1996). Figure 1 shows that the lattice distortion is higher in the archaeological powder than in the geological powder. The archaeological powder has been finely ground: the SEM observations reveal a heterogeneous assembly of small cubes ranging from 20µm to 150µm long, with a significant fraction of smaller grains. Extending this type of analysis over other archaeological galena powders shows that the galena was more or less finely ground by the Egyptians and sorted as a function of size, to obtain either a black mat powder, or grey powders with metallic overtones.

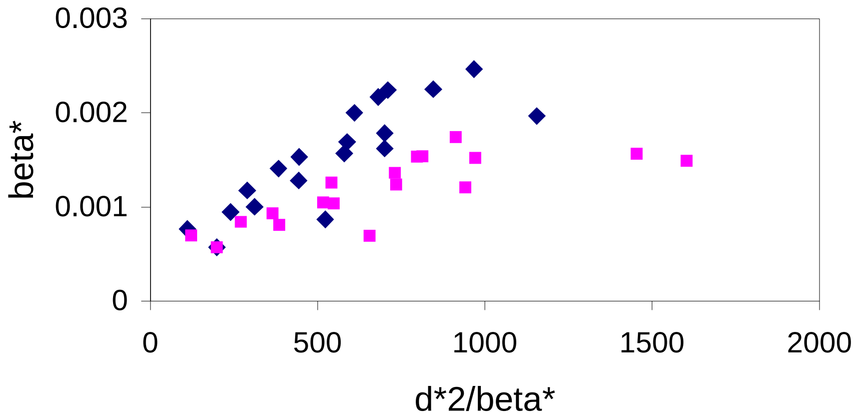

Figure 1: Williamson-hall diagram in reciprocal space (by the method of integral width) of archaeological (lozenges) and geological (squares) galena powders.

The microstructure of the archaeological laurionite powder (PbOHCl) has also been looked at and compared with that of a powder synthesised in the laboratory (Figure 2). Only the size effect contributes to the peak broadening of the laurionite pattern, whereas both size and strain effects were present in the galena diffraction lines. Both the archaeological and the synthetic laurionite powders have similar behaviour and their crystal size can be evaluated at 1000Å. The SEM study of these powders shows that the laurionite is composed of small grains, of about 1µm. This reinforces the hypothesis of the chemical process of preparation of this Pb-Cl compound. The synthesised laurionite, obtained in the form of very fine powders, has probably been incorporated into the make-up for therapeutic applications.

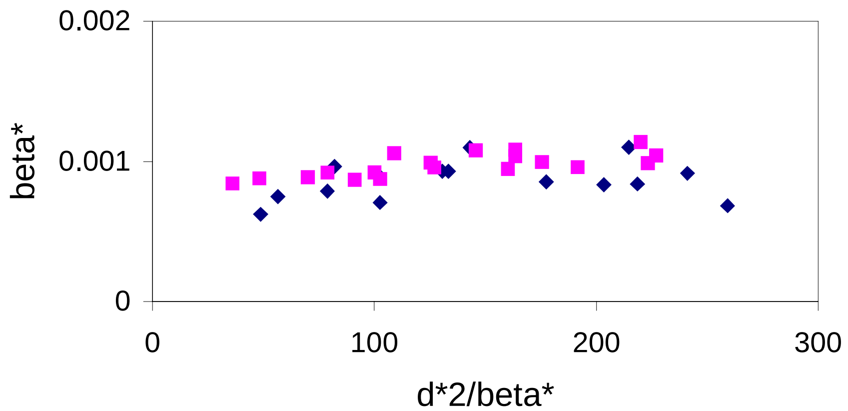

Figure 2 Williamson-hall diagram in reciprocal space (by the method of integral width) of archaeological (lozenges) and synthetic (squares) laurionite powders.

The case of galena and laurionite has illustrated the information, which can be obtained from the analysis of diffraction peak broadening. Such analyses should shortly be applied to other compounds found in the cosmetic powders from Ancient Egypt. Furthermore, a more detailed study is being carried out at present, based on the interpretation of the overall peak profile by Fourier analysis.

References :

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