

Thermoanalytical Study of Ancient Materials and Light It Sheds on the Origin of Letters and Words

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Ever since end of the 18th century, when Klaproth analyzed some ancient glasses, chemists in increasing numbers have been fascinated by the things that chemical and thermal analysis can tell about ancient history, ancient way of life, including the technical processes and the chemical substances used by the ancients, and patterns of the ancient world.

By its very nature, archeological chemistry, which includes the thermoanalytical methods, has had its own distinct parameters all along, the unique quality and the values of the objects analysed have always been a goad towards the development of micromethods or, ideally, of complete non-destructive methods. As the number of analyses of artifacts increases and the composition of large groups of artifacts reveals patterns which are becoming more useful for determining the time, place and method of manufacture, other specific considerations emerge: accuracy and precision in the context of their archeological significance.

The paper will show how thermoanalytical methods, as DSC, TG thermo-microscopy and TMA are applied in investigations of ancient materials. Thermomechanical analysis TMA is used especially for the determination of the calcination temperature of pottery and in combination with thermogravimetric measurements for the determination of the age of production.

The thermal synthesis of pigments helps to find out the nature of technical processes used in ancient times, by comparison of the old and new products. Simultaneous thermogravimetric TG and mass spectrometric measurements MS allows to analyse the flux additions for such solid state reactions and also of other organic materials present in ancient materials and defects. Another thermal investigation was concerned with the composition of ancient Egyptian mummification salts. The alloys of ancient Chinese coins could be determined with a combination of chemical- and thermoanalytical methods whereby only a small amount of sample is required.

Methods such as DTA, TG and TMA and thermo-microscopic investigations proved to be useful for the evaluation of historical papyrus and paper. Differences found in the thermal behaviour, e.g., shape and position of the DTA peaks in function of temperature could be assigned to changes in the composition due to the "paper technology" used or to the influence of fungi. For these studies, a wide variety of materials was used, including some dated original ancient papyrus from the Mediterranean area and paper of East Asia. Thermoanalytical methods also proved to be very useful in the study of ancient Chinese silk materials and their production method. These investigations included the complete biological cycle from the silk worm through the eggs to the cocoon and the individual silk fiber.

Compositions and changes of ink raw materials are also included in these thermoanalytical considerations. Finally the influence of ancient materials and processes on the evolution of letters and words and their meaning will be shown for Egyptian and Chinese writing.