



## **Archaeological and Forensic Chemistry**

Lecturer: Dr hab. Magdalena Śliwka-Kaszyńska (WCh)

Monographic lectures for PhD students (15 hrs)

### **Description**

The course aims to make PhD students familiar with those aspects of chemistry that are most applicable in the study of archaeological and cultural objects: organic and inorganic chemistry of ancient material, and analytical techniques used to study problems related to art and archaeology. The course will consider ways in which archaeological artefacts can be analyzed chemically to yield information about the technology of their manufacture, their provenance and their date. Celebrated cases of fakes and forgeries will be discussed.

### **Course Objectives**

1. Providing students with some grounding in the application of natural science to the solution of problems related to Art and Archaeology, problems that can help unravel human history.
2. Instigating in the students an appreciation of the complementary contributions of the humanities and science to the study of a particular phenomenon.
3. Enhancing the student's analytical ability and skills to solve problems related to fakes through case studies of forgeries. The approach will be interdisciplinary.

### **Course Outcomes:**

1. Appreciation of the difference between the methods used on the one hand by the archaeologist and the art historian and those on the other hand used by the scientist with special focus on the latter;
2. Understanding and appreciating a spectrum of analytical tools applied to the study of archaeological materials;
3. Developing in the students the ability to determine the appropriate tools needed to address in to a particular case of forgery or to address a particular archaeological problem;

### **Topics**

General Introduction

1. General overview of how science helps to unravel human history , early investigations, the growth of scientific archaeology in the 20th century, current status and scope of archaeological chemistry , the type of archaeological materials.

2-4. Analytical techniques applied to archaeological materials

Magnification: Optical microscopes, Scanning Electron microscope;



Elemental Analysis: infrared spectroscopy, infrared reflectography, X-Ray Fluorescence Spectroscopy, Raman spectroscopy, Inductively Coupled Plasma-

Optical Emission Spectrometer, CN Analyzer, Neutron Activation Analysis;

Isotope Analyses: Oxygen, Carbon, Nitrogen and Strontium isotopes, mass spectrometric techniques;

Organic Analysis: Methods of Organic Analysis, Gas/Liquid Chromatography-Mass Spectrometry;

Mineral and inorganic Compounds: Petrography, X-Ray Diffraction, IR Spectroscopy.

5-6. Pigments, Colors and binders: its significance and production

Classification and characterization of pigments, their ephemeral properties, origin and history, restoration, conservation, authentication, the palette of colors and painting techniques according to the art eras.

Practical examples: The Hitler diaries, color production in Ancient Egypt

7. Art under scrutiny, scientific detection of forgery in paintings

Practical examples: The Van Meegeren Forgery; Total analysis of Memling 's Gdansk "Last Judgment"

8-9. Dating techniques incorporated in some case studies

Radiocarbon dating, fluorine dating, racemization of amino acids, thermoluminescence dating, Potassium Argon dating

Practical examples: The Piltdown Fraud; The Shroud of Turin

10. Obsidian characterization in the Eastern Mediterranean

Origin and formation of obsidian, sources of obsidian in the Eastern Mediterranean and neighboring regions

11. The chemistry and Corrosion of Archaeological Glass

The structure and chemistry of glass, the color of glass, the decay of Medieval window glass, the corrosion of buried glass.

12. The chemical study of metals - the European Medieval and later brass industry

The production methods of brass in Antiquity, the early history of brass and zinc, the chemical analysis of metal objects, chemical analysis of European brass tokens and coins.

13. The chemistry and use of resinous substances

Definition, chemistry and uses of resins, monoterpenoids, sesquiterpenoids, diterpenoids, triterpenoids, analysis of resins in archaeological contexts, neolithic tars and birch barks.

14. The geochemistry of clays and provenance of ceramics

The structure of clay minerals, the firing of clays and the mineralogical composition of ceramics, trace element geochemistry in clays, the provenance of archaeological ceramics: Roman finewares.

15. Mummification

The chemical procedure of mummification in Ancient Egypt.



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