X-ray Spectrometry activities in 2019

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XRF group 2019

- Andreas Karydas, Head of XRF-Lab

Collaborators:
Vasiliki Kantarelou, Maria Kaparou, Georgios Mastrotheodoros, Eleni Kokiasmenou, Manos Manousakas

Students:
- Nelly Kladouri, PhD, University of Peloponnese, in progress
- Kalliopi Tsampa, MSc thesis, NTUA, in progress
- Sotiria Symeonidi, Diploma, NTUA, Completed November 2019
- Savvina Fotiou, MSc thesis, CultTech, Completed July 2019
Research Activities

Development of X-ray spectrometry methodologies & applications
- XRF-Lab Elettra (2 beamtime)
- AGLAE (1 beamtime)

Cultural Heritage

Environmental research

Biomedicine

Advanced Materials

Geochemistry

Spin-off

Knowledge Technology Transfer Services

Services
- ATC - TSAMPAS BROS S.A.,
- Magnisia Ephorate of Antiquities
- Finnish Institute at Athens
- Benaki Museum

Development of XRF Spectrometers for tailored applications

Peer Review/Abstracts

MSc students
- Five (5) - University of West Attica
- One (1) - University of Peloponnese

Improvement/Development of quantification models/approaches

Gamma X-ray Emission

X-ray Spectrometry
- Elettra (2 beamtime)

X-ray Fundamental Parameters

Resonant Raman Scattering

Services

ATC - TSAMPAS BROS S.A.,
Magnisia Ephorate of Antiquities
Finnish Institute at Athens
Benaki Museum

Three (3) Technical Reports

Five (5) - University of West Attica
One (1) - University of Peloponnese

MSc students

1/7 Cultural Heritage

4/1 Environmental research

1/1 Advanced Materials

1/0 Biomedicine

1/0 Geochemistry

1/1 Resonant Raman Scattering

1/1 X-ray Spectrometry Elettra (2 beamtime)

1/0 Fundamental Parameters
Scientific outcome (2019)

9 publications in peer–review journals
1 invited plenary talk + 3 oral
8 poster presentations

Education (2019)

1 MSc thesis completed
1 Diploma work completed
6 MSc theses supported
Experiments at large scale facilities - 2019

Elettra Sincrotrone Trieste, Trieste, Italy

1) “Study of deep-implanted multilayered structures in silicon wafers with IBA (Ion Beam Analysis) and Grazing Incidence X-ray Fluorescence Spectroscopy”, E. Ntemou

2) “A systematic study of the inelastic LM Resonant Raman scattering process on Au and of the cascade Au-M emission to improve the non-invasive XRF characterization of ancient/historical gold artefacts and of gilding layers”, K. Tsampa

3) “Measurements of different physical parameters for Sb at energies across its Li edge energies using synchrotron radiation.”, S. Symeonidou

4) “Study of low probability atomic processes by Resonant Inelastic X-ray Scattering”

Accélérateur Grand Louvre d'Analyses Elémentaires – AGLAE, Paris, France

1) “Provenance study of Mycenaean Gold”, M. Kaparou, K. Tsampa, N. Kladouri
Deviations from theoretical estimations due to the combined influence of the many-body and chemical environment effects, overall error in the present measured intensity ratios is estimated to be \(~3–5\%\)
Advanced materials characterization—Deep Implanted ions

Collaboration with TU of Athens

μ-XRF QC of periodic ZnO nanostructures fabrication

Micro-XRF as non-destructive and enabling nanometrology technique that can leverage the development of novel nanofabrication processes

Results of μ-XRF can be used to evaluate non-destructively the uniformity and homogeneity of seeding layer’s nanotopography and can be used to reveal possible correlations to the subsequent lithographic steps and hydrothermal growth of nanostructures

3-step Fabrication Process combining bottom-up (sol-gel + hydrothermal growth of nanostructures) with top-down fabrication methods (e-beam lithography)

P. Papageorgiou, A. G. Karydas, V. Kantarelou, G. Papageorgiou, E. Makarona, Combining bottom-up and top-down approaches with micro X-ray fluorescence spectroscopy for controllable fabrication of periodic ZnO nanostructures, presented at 45th International Conference on Micro & Nano Engineering, Rhodes Greece, September 23rd - 26th, 2019
K-means clustering and non-negative matrix factorization were applied for image segmentation of acquired elemental distribution maps into three sub-regions corresponding to stromal area, tumour area and unclassified area. Great potential in the investigation on the role of micro and trace elements in tumour biology.

AGH University of Science and Technology. Poland

Scutiger pes-caprae

EXAFS spectrum

S1: di-thiolate - Hg(S-R)₂
S2: tetra-thiolate - Hg(S-R)₄

Hg in examined mushrooms from non-polluted environments is mainly bound to di-thiolate (43-82%) and di-selenol (13-35%) ligands and less to tetra-thiols (12-20%), while at Hg polluted sites the proportion of di-selenol and tetra-thiol ligands increases.

University of Ljubljana, Józef Stefan Institute

Knowledge of the REE-, Th- and U-bearing phases has key implications for the economic viability of the said placer deposits and the potential environmental impact of their beneficiation.

MA-XRF imaging of Bronze Age Wall-paintings

MSc Diploma thesis: Eleni Kokiasmenou

Training of MSc students

Analysis of painting blue material used to cover the surface of a Zoetrope, a pre-cinema optical toy from the Greek Film Archive collection © T. Vazelaki, MSc thesis

Investigation of pigments on printed silk fabric of the collection of the National Historical Museum, © N. Tasiouli, MSc thesis

Analysis of pigments on Russian icons from the Benaki Museum collection, 16th-20th c. © A. Kalliga, MSc thesis, Benaki museum

Analysis of inks and deteriorations the working drawing (anthivolo), "The Holy Trinity" from the Chioniades painters' workshop. © A. Papacharalambous - Kritzali, MSc thesis

In-situ XRF measurements at the “Bema of Phaidros” within the Dionysos Theatre located at the south slopes of the Acropolis hill. © K. Kallinteraki, MSc thesis © Ministry of Culture and Sports /Athens Ephorate of Antiquities
The Challenge (2019-2023)
The main aims and objectives of the Action is to coordinate the efforts made at national and transnational level to establish total reflection X-ray fluorescence (TXRF) as a reference technique for reliable elemental analysis of solid and liquid matrices, for the purposes of both fast screening and accurate quantitative determination. These objectives will be achieved via the development of a strong TXRF network, building capacity by training, connecting and involving stakeholders.

Structure
The Managing Committee (MC) decided on the following Working Group (WG) structure for the Action:

- **WG1 - Instrumentation, modelling, data evaluation and software**
- **WG2 - Metrology and standardization**
- **WG3 - Sample preparation and analytical procedures**
- **WG4 - Performance Assessment and Data Analysis**

Thematic Sub Groups (SG) are also established:

- **SG Environment**
- **SG Surfaces and Thin Films**
- **SG Bio-medical Diagnostics**
Outlook – Future perspectives

➢ Awaiting evaluation for 4 “Research + Innovation” projects + 1 “ELIDEK PostDoc” + 1 infrastructure EU project H2020-INFRADEV-2019-3 “GEOANT-Labnet”

• Continuation of basic and applied research activities at Elettra Sincrotrone Trieste
  Study of X-ray FPs of key elements: Ge, Sb, Re, Hf, Au
  Systematic Resonant Raman Scattering studies on Ge, Au

• Continuation of “Myc-GoldPro” project in all “fronts”:
  Beamtime @AGLAE, XRF-lab measurements, in-situ campaigns at Greek sites
  Goal: XRF-Lab to be connected with the European Research Infrastructure Cultural Heritage (ERICH) as infrastructure within the National Greek node (ERIHS.gr)

• Further strengthening of the strategic partnership with LANDIS group at INFN-LNS, Italy to be equipped next year with state of the art X-ray instrumentation (3ME) but also with: INN at NCSR-D, University of Ioannina, University of Thessaloniki and University of Peloponnese
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Physicist

Dr Georgios Mastrotheodoros
Conservator/Archaeometry specialist

Ms Nelly Kladouri,
Conservator/PhD Candidate

Ms Kalliopi Tsampa
Physicist, MSc NTUA
Erasmus at AGLAE

➢ Dr. Paolo Romano, LNS- INFN Laboratori Nazionali del Sud & CNR, Istituto per i Beni Archeologici e Monumentali (IBAM)
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