To the Editor

*Acta IMEKO*

Dear Editor,

 please find enclosed the paper by D. Moro, G. Ulian and G. Valdrè entitled:

**“Mineral diagnostics: SEM-EDS Monte Carlo strategy for optimized measurements of ultrathin fragments in Cultural Heritage studies“**

for your kind consideration for publication in “MetroArchaeo 2019” Special Issue of *Acta IMEKO.*

*General description of the submission:*

The availability of tiny quantity of sampling material is often an issue in the context of cultural heritage and archaeology, due for instance to the preciousness of the sample, its unicity, or the small amount of residual material which testify the original form of the work of art that has to be restored.

In this context, electron-excited energy dispersive X-ray spectrometry (EDS) performed in a scanning electron microscope (SEM) has proven to be a primary methodology to analyze tiny quantity of material thanks to its morphological and micro-analytical capability. However, when dealing with micro- and sub-micrometer specimens, as often found in cultural heritage and archaeology (e.g., the case of ultrathin glass and metal fragments), several and complex effects due to the physics and operational settings of the measurement must be taken into account to avoid quantification errors.

In the present work, a detailed study of the effects related to micro- and nanometric sizes of glass and gold alloys fragments on SEM-EDS quantitative microanalysis is presented. Monte Carlo simulations of different kind of elongated glass fragments with square section, from 0.1 µm to 10 µm thick, and of some gold alloy layers, resembling those found in glass mosaic tesserae, showed a strong influence of the fragment sizes and operational conditions (beam energy, detector position, etc.). The results can be used to identify the potential error sources and the optimal experimental settings necessary to improve the accuracy of the quantitative microanalysis of this kind of material, avoiding analytical errors and misinterpretations, and devising an appropriate and optimized measurement strategy.

As requested, you can find in the following a list of modifications and improvements of the original Conference paper, which have been done taking into account progress since the MetroArchaeo 2019 Conference submission and discussions at the Conference:

* All the images of the submitted paper are related to new and original data;
* New data and images related to electron trajectories into ultrathin fragments were provided.
* New data and figures related to the progress of the Monte Carlo simulations on ultrathin glass fragments (i.e., data and trends on further X-ray emission lines of the different glass type fragments) were added;
* New data and figures related to the progress of the Monte Carlo simulations on ultrathin gold layers (i.e., data and figures on the combined effects on X-rays detection of a variable layer thickness and different azimuthal angles of the detector) were added;
* The discussion of the results was extended, being removed the size limitations the Conference required for its proceedings.

Looking forward to hearing from you

Yours sincerely

Daniele Moro, Gianfranco Ulian and Giovanni Valdrè

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