

Fast chemical mapping of archaeological objects with a novel X-ray Color Camera

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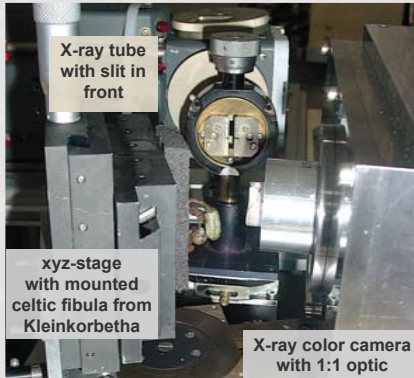


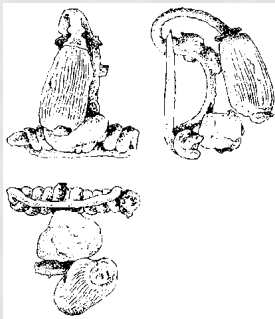
Image area	11.9 x 12.3 mm ²
Pixel size	(48 x 48) μm ²
Number of pixels	69696 (264x264)
Pixel readout speed	28 MPixels/s
Frame rate	400 Hz
Energyresolution	152ev (MnKa)
Quantum efficiency	>95% @ 3-10keV >30% @ 20keV
Readout noise	<3e ⁻ /Pixel
Charge transport efficiency	>0.9999



Experimental setup of the X-ray color camera with 1:1 optic combined with a laboratory Mo-sealed tube and celtic fibula in measurement position. Technical data of the detector chip and X-ray color camera with a magnifying 6:1 polycapillary optic. ^(1,2)

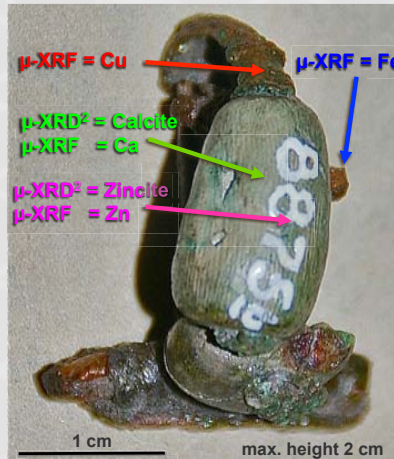
Object:

Celtic „coral“ fibula with two beads - Late La Tène Time: burial site Kleinkorbetha (Kreis Weißenfels), east-central Germany (excavation since 1870, systematic excavation since 1897)



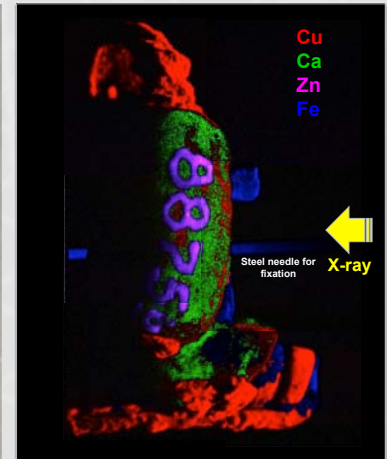
Celtic fibula Kleinkorbetha 8875b, Bronze corpus with Fe stick & 2 carbonate beads ⁽³⁾ X-ray computer tomography Z-summation of radiograms: fibula type & bead arrangement ⁽⁴⁾

Fibula provided by Dr. R. Mischker „Sammlung des Landesamts für Denkmalpflege und Archäologie Sachsen-Anhalt“ Halle



Color camera picture of fibula

Arrows show regions with results of local analysis by μ-XRD² (BRUKER D8 GADDS) and μ-XRF (PRAXIS)



X-ray color camera picture of fibula

1:1 optic, 6 pictures each 10 min, source sealed tube Mo anode (50kV/40mA unfiltered)

Methodical resumee:

- For the first time direct „pictures“ of the elemental distribution of 3-dimensional objects are possible.
- Standard laboratory X-ray sources are sufficient for the measurements, no synchrotron radiation necessary.
- Local resolution and area of interest simply adjustable by changing optics.
- With 1:1 optic almost infinite depth of sharpness => ideal for 3-dimensional objects without any focussing effort.

Archaeological resumee:

- Fast and local highly resolved chemical „3D-pictures“ are confirmed by time consuming and only local μ-XRF/μ-XRD²-analysis.
- Zincite (ZnO) is the typical white pigment used before app. 1910 => in good agreement with excavation time.
- Optical, X-ray tomography and separate μ-XRD² analyses give no evidence for the commonly suggested corals as bead material
=> Implications on till now assumed trade routes and relations? ⁽⁴⁾

Literature:

- (1) Scharf, O. et al., (2011) Compact pnCCD-Based X-ray Camera with High Spatial and Energy Resolution: A Color X-ray Camera, Anal. Chem., Vol. 83(7), pp. 2532-2538
- (2) Ordavo, I. et al., (2011) A new pnCCD-based color X-ray camera for fast spatial and energy-resolved measurements, Nucl. Instrum. Methods Phys. Res. Sec. A 654(1) pp. 250 – 257
- (3) Grünert, H. (1967) Studien zur Produktion bei den Stämmen des Mittelalb-Saale-Gebiets, (Habilitationsschrift) Berlin 1967
- (4) Bente, K. et al. (2012) Archäometrische Studien an mitteldeutschen Korallenfibeln – eine Zwischenbilanz, GNNA Meeting 2012



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