

Neutron radiography studies of the Przeworsk culture objects from Czersk

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The remnants of Przeworsk culture (from 2th century BC to 3rd century AD) have been found in many sites of Poland (Lower Silesia, Greater Poland, central Poland, and western Mazovia and Lesser Poland) for almost a century. Since the Przeworsk culture objects have some features of the Roman and Scandinavian products the studies of these artefacts are of unquestionable importance for European cultural heritage.

The results of the studies performed on several objects found at the Przeworsk culture burial site at Czersk (central Poland) are presented. This ancient cemetery has been thoroughly searched since 2008. The main experimental tool was the thermal neutron (white beam) radiography supplemented with X-ray, neutron diffraction, SEM and laser ablation techniques. The study dealt with few clearly identified objects like metal parts of an ancient shield and burial urn as well as few initially unidentifiable aggregates of many different objects found at the excavation site. The neutron imaging helped in identification of their components.

The main objects investigated came from a shield excavated at Czersk and comprised the central part and the handle with an unique silver cladding. Elemental composition of the artefacts was determined SEM with Energy-dispersive X-ray analysis and Laser Ablation Inductively Coupled Plasma Mass spectrometry. The bronze alloy was confirmed as a main component of the objects' body and the silver was identified in the handle cladding. The results were compared with tests carried out for two fibulas found at the same site. The ornaments on the surface of the handle were revealed with neutron imaging despite significant corrosion decay. The phase composition of the bronze alloy forming the handle was determined with X-ray and neutron diffraction. In particular the small angle neutron scattering revealed an advanced phase decomposition stage of the bronze in nano-scale.

Three heavily corroded aggregates of the initially unidentifiable objects were carefully studied with neutron imaging. The inspection of the neutron images revealed the presence of the spear or arrow heads, clip and spur parts clumped together inside of the objects.

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