

Nuclear analytical techniques and neutron imaging in material culture

Maria Isabel Prudêncio

*Centro de Ciências e Tecnologias Nucleares (C2TN), Instituto Superior Técnico, Univ.
Lisboa, EN 10 (km 139.7), 2695-066 Bobadela, Portugal*
*Departamento de Engenharia e Ciências Nucleares (DECN), Instituto Superior Técnico,
Univ.Lisboa, EN 10 (km 139.7), 2695-066 Bobadela, Portugal*

The methodological approaches to study ancient materials vary depending on the nature of the object, the raw materials used, the manufacturing techniques, and the degradation state. Research began by a careful examination of the ancient materials. In many cases micro-invasive or non-destructive methodology is required by the artwork typology. The application of nuclear analytical techniques (NATs) in support of provenance research of ceramic, lithic and other materials has been largely used over the past few decades worldwide. Instrumental neutron activation analysis (INAA), requiring a very small sample for analysis, and prompt gamma activation analysis (PGAA) have been used to help solve many archaeological and historical questions. INAA has also been used successfully to obtain precise and accurate concentrations of natural radioactive elements such as potassium, thorium and uranium aiming to evaluate the dose rate, which is fundamental for luminescence dating of cultural materials and archaeological contexts. In this talk, advantages of nuclear methods of analysis are discussed with examples of applications to diverse types of archaeological and historical materials.

Neutron imaging techniques can be used for non-invasive investigations, visualizing the inner structure of cultural objects. Since most of the light elements have stronger interaction with neutrons, neutron tomography is especially useful for example for the inspection of fluid penetration in ancient glazed tiles, with the three dimensional visualization of dynamic processes.

Together with the expertise of the archaeologists, art historians and museum experts, NATs and neutron imaging data can contribute to the description of artifacts, their history, manufacturing process and conservation state.