

Neutron tomography and gamma spectroscopy applied to bronze sculptures: a non-destructive and safe analysis

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Neutron imaging is one of the advanced tomography techniques similar to X-ray scanning with an outstanding ability to visualize the internal structure, in a non-destructive way. Contrary to X-rays, which interact with the electrons of the atom, neutrons dominantly interact with the nucleus of the atom since neutrons are electrically neutral. Therefore, neutrons have a remarkable penetrating ability for metallic materials, while neutrons are also quite sensitive to light elements which have higher interaction probabilities with neutrons than X-ray. Neutron imaging, although only developed since approximately two decades, has emerged as one of the most powerful neutron technologies, complementing X-ray scanning, notably in the research fields of material science and cultural heritages.

Since a few years, Rijksmuseum Amsterdam, the national Heritage Agency (RCE) and NPM2, a group of TU Delft, are collaborating in a project called “Beeldvorming”. In this project, we combine neutron tomography (using the FISH neutron imaging facility located in Reactor Institute of Delft) with gamma spectroscopy, to inspect the interior of heritage objects, including information not only on the internal geometric structure but on the elemental compositions as well. In addition, this technology allows visualization of the corrosion state and the internal porosity, from which the preservation strategies can be optimized and the fabrication technique can be inferred. In the “Beeldvorming” project, we focus mainly on bronze objects, such as bronze statues, tools, decorations, etc.

Here we will present our research on the bronze statue of Kuvera (11.5 cm x 6.6 cm x 5.9 cm x 488 gr, AK-MAK-311, Rijksmuseum, Amsterdam, Netherlands), see Fig. 1. It represents the god of prosperity Kuvera or Jambhala within Hindu and Buddhism culture; the statue is probably dated to the 9th or 10th century in Java, Indonesia[1]. The hollow pedestal is partially filled with lead, cast after the fabrication of the statues and a portion of a yellow foil can be observed sticking out a bit underneath the lead.

We will demonstrate how neutron tomography allows us to reveal such precious “mantra’s”, hidden inside the lead, and how we can identify those objects and composition of the solid cast bronze, non-invasively. The information that we collect in this way serves to gain insight into the craftsmanship and culture of the Chola dynasty and, at the same time, assist curators and conservators to make decisions on such museum collection objects, and strategies in preservation, conservation and restoration.

[1] <http://hdl.handle.net/10934/RM0001.COLLECT.1979>

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