

X-ray micro-tomography as a method to distinguish and classify natural and cultivated pearls

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Digital radiography and computed tomography are two fundamental diagnostic techniques in different fields of research, including Cultural Heritage studies and gemmology; the application of these physical methods of investigation has gained considerable importance thanks also to their non-invasiveness. It is in fact of great importance to obtain information on the “invisible” parts of a work of art, of an artifact or, more generally, of any sample, without compromising its integrity. In particular, with X-ray CT the three-dimensional reconstruction of an object is performed starting from 2D projections acquired at different angles, in order to obtain useful knowledge on the entire volume of the object.

The presented work has been mainly focused on micro-tomographic analysis, developing a custom instrumentation based on a microfocus X-ray source and a TDI X-ray detector, both from Hamamatsu, and a high-precision rotary stage. The setup geometry has been adapted taking into account the necessity of fast measurements (maximum 2 hours) and the need of a high resolution (in the order of 10 micrometers).

The project, developed within the Physics Department of the University of Turin and INFN, in collaboration with the spin-off TecnArt S.r.l. and with the R.A.G. gemmological laboratory in Turin, concerned the micro-tomographic study of natural and cultivated pearls with the aim of developing an investigation methodology for the analysis and classification of different types of pearls, some of them belonging to different precious jewels from private collections. The distinction between natural (naturally produced by marine or freshwater pearl molluscs) and cultivated (produced as a result of human intervention) pearls has never been simple and it has recently become even more difficult with the large number of cultivated pearls sold nowadays. In this case, the use of micro-tomography as a diagnostic technique can provide clear evidence on their origin thanks to the possibility to visualize their internal structure and to study the grey levels variation in the images (due to the different absorption of X-rays by materials in the object).

The investigations, carried out on a total of 22 heterogeneous types of pearls (both free-standing and part of precious jewellery, such as two pairs of earrings and a brooch), allowed to establish the origin of the pearls (natural or cultivated) or to confirm/deny it if a hypothesis was already expressed, and to highlight as well the cultivation methodology used case-by-case. Furthermore, it was possible to ascertain how large and varied the market for cultured pearls is nowadays and how difficult is, in some particular cases, their attribution to a certain origin.

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