

Colouring and Opacifying Agents in Roman Glass: a Multi-technique Analytical Approach

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Many samples of opaque Roman glass of different typology (mosaic tesserae, game counters, vessels and artefacts) and colours (red, green, yellow, white and blue) coming from different Italian archaeological sites have been analysed to identify and characterize the colouring and opacifying agents.

The chemical analyses were carried out using wavelength dispersive electron microprobe (WDS-EMPA), the crystalline phases used as opacifiers were identified using both an automatic powder diffractometer (XRPD) and a Gandolfi camera. Secondary electron (SEM) and backscattered electron (BSE) images were performed to study the distribution and morphology of the opacifier particles, whereas their qualitative chemical analysis was obtained with an energy dispersive system (EDS). Moreover X-ray absorption spectroscopy (XAFS) and XPS studies have been performed on green and red samples to investigate the influence of coordination and oxidation state of copper atoms on colour and opacity of the glass. These analyses allowed to conclude that, in the most of the red opaque samples, copper is mainly present as metallic nano-clusters, accompanied by monovalent copper coordinated to the oxygen atoms of the glass framework, whereas in few ones, it is present as less stable cuprite crystals, leading to a more weathered glass. In green samples, both Cu⁺ and Cu²⁺ were detected, both incorporated in the glass matrix, the second one being responsible for the colour of the artefacts.

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