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Laboratory and synchrotron x-ray computed microtomography to investigate corroded Roman glass

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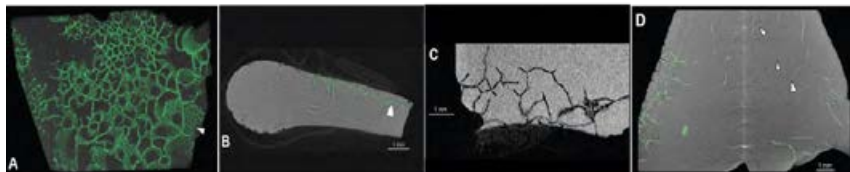
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Computed tomography (CT) is a non-destructive diagnostic technique ideal to obtain structural and compositional information from cultural heritage objects [1,2]. This work explores, in a non-destructive manner, the 3D inner structure of ancient glass fragments using both laboratory X-ray micro-computed tomography (μ CT) and phase contrast synchrotron X-ray computed microtomography (SX μ CT). For this purpose, three degraded glass samples affected by diffused 3D cracking were characterized combining medium resolution scans obtained with the UniTO-INFN laboratory CT instrument (in the framework of the OpenAIAr project [3]) and high-resolution synchrotron radiation microtomography at Elettra Sincrotrone (Proposal n. 20222195). The μ CT scan allowed to visualize the cracks in the reconstructed volume and to appreciate their internal structure and size (voxel size between 7 μ m and 11 μ m). Several cracks totally filled with mineralized material, possibly coming from the soil in which the object was buried for centuries, extend into the bulk below the glass surface as visible in the slices reported in the figure below. The scans collected from SX μ CT enable 3D reconstruction with higher spatial resolution (up to \sim 2 μ m), and so to observe in detail the distribution of the material filling the fractures. The grains of the soil are clearly distinguishable as well as the areas into the cracks where air is present. Compared to μ CT, the SX μ CT scans highlight the welding effect of the material inside the cracks that seems to act as cement between the single glass fragments. This result turns high-resolution μ CT analysis to be a valuable technique to aid restoration interventions on glass objects, when cleaning actions are required to remove adventitious soil from the cracks, and the loss of cohesion between the fragments of unaltered glass must be avoided.



[1] L. Vigorelli, A. Re, P. Buscaglia, N. Manfredda, M. Nervo, T. Cavaleri, P. Del Vesco, M. Borla, S. Grassini, L. Guidorzi, A. Lo Giudice, *Journal of Archaeological Science: Reports* 44 (2022) 103518.

[2] F. Albertin, M. Bettuzzi, R. Brancaccio, M.P. Morigi, F. Casali, *Heritage*. 2 (2019) 2028–2038.

[3] <https://www.associazioneiair.com/wp/openaiar/>