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Innovative techniques for the assessment of the degradation state of metallic artefacts

Manuel J.H. Peters

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Supervisors
Prof. Emma Angelini, Supervisor, Politecnico di Torino
Prof. Sabrina Grassini, Co-supervisor, Politecnico di Torino
Prof. José Mirão, Supervisor, Universidade de Évora
Prof. Carlo Bottaini, Co-supervisor, Universidade de Évora

Doctoral Examination Committee:
Prof. Panayota Vassiliou, Referee, National Technical University of Athens, Greece
Prof. Tilde de Caro, Referee, Istituto per lo Studio dei Materiali Nanostrutturati, CNR, Roma, Italy
Prof. Claudio Badini, Politecnico di Torino, Torino, Italy
Prof. Giulio Malucelli, Politecnico di Torino, Torino, Italy
Prof. Alessandro Re, Università degli Studi di Torino, Torino, Italy

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Summary

The degradation of archaeological metals is largely dependent on factors such as alloy, microstructure, and environmental parameters. Commonly, these issues are targeted within specific disciplines such as materials science, archaeometry, conservation science, archaeometallurgy, and geoarchaeology. The topic could benefit from an integrated transdisciplinary approach, combining different techniques and approaches. It is of importance to consider that artefact degradation not only relates to the general soil environment of the region, but can also depend on local variations in soil conditions within an archaeological site, and there can even be variations within the same artefact. Additionally, the conditions in an archaeological site are not a fixed stable situation; rather, environmental change can have a significant impact on the future preservation of artefacts in situ. This thesis applies several methodologies on a range of scales. First of all, a Roman site in Israel is considered, where there are anthropogenic influences influencing the soil conditions. Continuing on this topic, another Roman site, in Portugal, is studied through intra site-investigations into local soil conditions and corrosion products, by analysing a large number of soil and corrosion samples in combination with digital and statistical methods. Next, 3D recording and data visualisation techniques are applied to a Chalcolithic site in Israel. Then we move towards the use of non-invasive techniques to identify artefact groups within one excavation of an Islamic site in Spain. On a smaller scale of analysis, fragments from a single archaeological context from a Latin site in Italy are studied, to interpret the variation of different corrosion products in the same location. The next level is the investigation of artefact-scale variety in corrosion products and elemental composition of the surface, within a 3D framework. This is done on a Chalcolithic halberd from Portugal. An even more detailed technique follows, by using micro-CT to assess microstructures and corrosion morphology of a variety of samples from different sites. Finally, future considerations into the changing environments are studies, by applying environmental models involving sea level change at a Phoenician site on Sardinia. Throughout the thesis, a selection of innovative techniques and approaches at different scales are applied, such as SEM, XRD, XRF, photogrammetry, measurements of pH and conductivity, 2D and 3D GIS, and micro-CT. This work comprises of several transdisciplinary workflows, and might serve to improve and inspire future studies related to archaeological materials.