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A Vibrational Spectroscopic Study of a Medieval Sword from the Collection of the National Museum of Slovenia

A late-medieval longsword (inv. no. N40037) from the arms and armour collection of the National Museum of Slovenia represents a fine example of the fourteenth-century German blade-making tradition, most likely produced in Passau or a related workshop. In addition to typological and stylistic study, scientific analyses were undertaken to investigate its state of preservation and possible past conservation-restoration treatments (Lazar, 2023).

Two micro-samples were taken from the metal surface and analysed using Fourier-transform infrared spectroscopy (FTIR) and Raman spectroscopy. The aim was to identify organic and inorganic components present on the surface and to clarify both historical conservation-restoration procedures and current corrosion processes.

Results revealed the presence of natural resin, probably of triterpenoid origin, mixed with oil, most likely applied as a protective coating. Protein bands indicated the use of animal glue, presumably as a binder or coating component. Corrosion products identified included oxalates-linked to biological activity or organic decomposition-and chukanovite ($Fe_2(OH)_2CO_3$), which forms under low-oxygen conditions in the presence of carbon dioxide. Raman spectroscopy confirmed the presence of iron oxide (Fe_2O_3) and revealed variations in vibrational bands across spectra from different particles, suggesting differences in crystalline phases, impurities, or degrees of degradation. These heterogeneities provide valuable insights into the sword's exposure to diverse microenvironments and potential historical interventions.

Additional detection of silicates points to environmental contamination, while further protein signals confirm the presence of organic residues from protective layers. The findings strongly support the conclusion that the sword underwent restoration in the early twentieth century, employing methods typical of that period, such as resin- and glue-based coatings.

Overall, the analyses demonstrate the coexistence of historical conservation layers with active corrosion processes. The identification of Fe_2O_3, chukanovite, and oxalates illustrates both the persistence of degradation and the long-term influence of environmental conditions. These results provide an essential basis for planning future stabilisation and conservation-restoration strategies tailored to the sword's current material condition.

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References

Lazar, T. (2023). A newly acquired medieval sword in the collection of the National Museum of Slovenia. *Acta Militaria Mediaevalia, 19,* 87–106.

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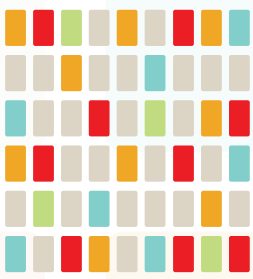

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