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Neutron diffraction for cultural heritage studies: the Italian Neutron Experimental Station INES

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The Italian Neutron Experimental Station INES, located at the pulsed neutron source ISIS (UK), is a general-purpose powder diffractometer built to focus its use on material science and in particular cultural heritage related studies. Thanks to the high penetration power of thermal neutrons, archaeometric measurements performed through neutron diffraction allow for quantitative determination of bulk properties of the sample in a non-destructive way. This opens up the possibility of investigating objects otherwise unsuitable, due to their cultural and/or historical importance. Here we describe the INES instrument and present the results on bronze objects from Sardinia and orichalcum ingots found in Sicily. The orichalcum ingots were previously investigated by XRF showing that the major elements were copper and zinc, in a ratio compatible with the mythological orichalcum, an alloy similar to brass. The neutron diffraction results were compared with the previous results, confirming that they represent one of the most suitable non-destructive approaches for the characterization of metal archaeological artefacts. The obtained results on Sardinian bronze objects showed a very specific procedure for sword forging and allowed for the determination of the bronze composition and microstructure. A comparison with contemporary bronze artifacts produced in the other areas of the Mediterranean area adds important details about the development and exchange of knowledge in this geographic area

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