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The use of time of flight neutron diffraction in bronze archaeometallurgy

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During the last years several works explored the potentials of neutron diffraction in the non destructive metallurgical characterisation of bronze artefacts. Despite the very interesting results in quantifying elemental and phase contents in binary and ternary alloys, as well as preferred orientation and residual stress distributions, the novel approach is still far from the common archaeometallurgical practice. In order to overcome a rather stationary situation, further insight aimed at enriching the analytical valence of neutron techniques and devising suitable integrations with other non-invasive methods are needed. Here, some recent developments in the use of time of flight neutron diffraction for investigating Middle Italy Iron Age bronze artefacts will be reported. Furthermore, the integration with other techniques and the general application perspective will be discussed.

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Towards an understanding of Damascene blades

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For centuries, armies relied on swords and those who possessed the weapons of better quality enjoyed a distinct advantage. Legends tell how Damascene swords, daggers or sabres - exhibiting extraordinary mechanical and optical properties - had been manufactured following secret recipes. Obviously, due to the migration of peoples various connections with other famous ancient steel recipes developed which were utilised in India, Russia and Western Europe [1,2]. In the early 19th century, the last secrets of the genuine Damascus steel got finally lost, but since that time several attempts have been performed to rediscover the recipes of achieving blades of comparable quality. Several questions remained open. During the last decades, however, more sophisticated metallurgical methods have revealed details of the microstructure and of the thermo-mechanical treatment needed to achieve a certain microstructure [3,4]. Using high-resolution transmission electron microscopy and X-ray diffraction we have analysed a specimen of a genuine Damascus sabre, which dates back to the 17th century. It was donated by the collector Henri Moser to the Historic Museum Berne and kindly left to one of us (W.K.) by E.J. Kläy (Berne). Significant new details of the microstructure that have been revealed during our study are nanowires of cementite Fe_3C [5-7] as well as carbon nanotubes [8]. Annealing at 800°C and subsequent slow cooling let the nanowires dissolve whereas the common cementite retained. These findings may facilitate a better understanding of both of the strength and the instruction of processing by the bladesmiths. Several aspects of them will be discussed.

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