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Non destructive determination of the manufacturing methods of ancient Indian blades and modern replicas through advanced applications of neutron tomography and neutron diffraction

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The analysis of the micro-structural features of ancient Indian blades has been carried out by neutron tomography and neutron diffraction. The results provide a clear identification of the different types of steel used to produce such weapons. Among them, only a small proportion of the large number of swords produced in India is made of hypereutectoid textured steel, namely wootz steel also known as "Damascus steel". The others present characteristics very similar to the European swords produced in the same period.
The swords and daggers, provided by the Wallace Collection in London and the Bernisches Historisches Museum in Bern, as well as the modern replicas made by a professional swordsmith, were analyzed using neutron tomography both in white beam and energy selective configurations and neutron diffraction to get quantitative phase analysis and pole figure reconstruction of the texture in cementite phase. The results permitted to determine the spatial distribution of the iron and steel components inside the swords and the size and orientation of the microstructure of the ferrite and cementite grains in the wootz steel.
These results are an important starting point to lead to the comprehension of the metal preparation and the forging procedure to produce swords made of wootz steel. This kind of results is a further proof of the validity of the use of neutron techniques for non destructive and quantitative authentication and characterization of ancient metal artifacts.

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