Crystallographic texture analysis: A non-invasive metallographic technique in archaeometry

ARTIOLI G.
Dipartimento di Scienze della Terra, Università di Milano

Texture analysis by diffraction methods has greatly advanced in the last few years because of instrumental and computational developments, and it is now to be considered a routine tool for the analysis of crystallite orientation in a wide variety of natural and man-made materials, industrial products and archaeological samples [1]. The advances in the experimental measurements are mainly linked to the use of flexible experimental setups at large radiation sources, such as synchrotrons and neutron sources, which allow faster data collection, the use of samples of any size, and complete coverage of texture and reciprocal space. The developments in the data analysis are mainly related to the use of the full diffraction profiles in place of the single-peak methods. This produces pole figures and orientation distribution functions (ODF) that are statistically more significant and less prone to biases in the data analysis. Furthermore it opens the possibility of analysis of complex polyphasic materials, which are hard to characterize by other experimental techniques [2].
If high energy X-rays or neutrons are used as penetrating probes, the technique can effectively be used as a powerful non-invasive tool for the investigation of thick objects such as metal artefacts (Figure 1). The recent results obtained on prehistoric copper axes will be described as case study showing the potential of crystallographic texture analysis in archaeometry [3].

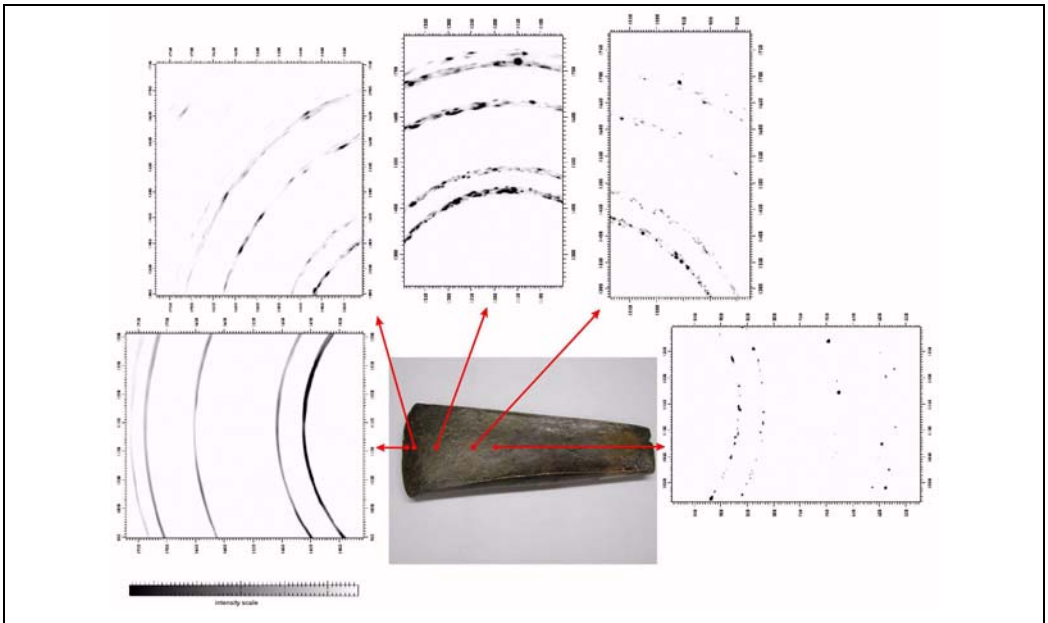

Figure 1: Diffraction profile through the Iceman copper axe by high-energy X-rays. Data collected at ESRF beamline ID15B.

References

[1] - U.F. Kocks, C.N. Tomé and H.–R. Wenk, *Texture and anisotropy*, Cambridge University Press, Cambridge, 676 p, (1998)

[2] - G. Artioli, M. Dugnani, Period. Mineral. 73, 5-16, (2004)

[3] - G. Artioli, M. Dugnani, T. Hansen, L. Lutterotti, A. Pedrotti, G. Sperl, Crystallographic texture analysis of the Iceman and coeval copper axes by non-invasive neutron powder diffraction. In: A. Fleckinger (ed.) "The Copper Age mummy. 2. New finds on the Iceman". Museo Archeologico dell'Alto Adige, Vol. 3, Folio Verlag, Bolzano, pp. 9-22, (2003)