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Powder X-ray diffraction investigations of materials from cultural heritage contexts

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The expanded availability of powder diffraction techniques using X-rays in terms of new sources, automatic instrumentation and software data analysis has made straightforward the structure characterization of many materials which deserve importance for their monumental and historical contexts. We will give an account of our recent studies performed on ancient mortars, ceramics, bronze coins and bones from the Phoenician-Punic and Roman periods which were brought to light during pluriannal excavations in various archaeological sites of Sardinia (Italy). The technology of lime mortars sampled from thermal Roman buildings has been assessed to be in general a simple mixture of lime putty (calcium hydroxide) and sand. The quantitative evaluation of calcite and quartz by the Rietveld method permits to assess with high precision the original mixture of minerals used during preparation of the mortar. Another example concerns the Egyptian scarabea found as funerary items of bodies in tombs, which turns out to be the enstatite phase MgSiO3. Very likely, the enstatite mineral derives from steatite after a hardening transformation reaction promoted by mild thermal treatment. The powder X-ray diffraction technique was suitable to assess the degree of alloying in old bronze coins. Sometimes, the presence of zinc sulphide phase (sphalerite) witnesses an unorthodox roasting process for the metal. Finally the X-ray diffraction diagrams can distinguish easily whether a bone belonging to a body was subjected to incineration or inhumation. In facts, the hydroxylapatite phase, which is the major mineral of bones, shows broad diffraction profiles in the case of inhumated bodies that becomes sharp after thermal treatment, as it can be brought about during the funerary rite of burning.

Keywords: phase analysis, ancient bronze coins, funerary rites

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New developments on the D19 state-of-the-art single-crystal neutron diffractometer

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D19 is a single crystal monochromatic thermal neutron diffractometer with proven applications in biology, chemistry, physics, materials and polymer science. A major grant from the EPSRC made possible the construction of a new area detector system on D19. The upgrade, which was given high priority as part of the ILL's Millennium Programme, has now been completed. To dramatically increase the